THE

ELECTRICAL REVIEW.

VOL. LVII. OCTOBER 20, 1905. No. 1,456.

ELECTRICAL REVIEW.

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REGENERATIVE CONTROL.

IN spite of the fact that the principle of regenerative control of tramcars has now been before the tramway world in actual operation for at least two years, and that the efficiency and economy of the system as proved in practice are indisputable, an extraordinary degree of apathy and indifference is manifested towards it. Why is this?

There is nothing new in the idea of regeneration—or recuperation, as, strictly speaking, it should be called. From the earliest days of the steam engine, when the hot water of condensation was first used for boiler feeding, at least two centuries ago, the recuperative principle has been practically applied, and, indeed, there are on record instances of its adoption dating back from time immemorial. British conservatism, therefore, need not complain of lack of precedent. We know of one instance of so-called "regeneration" on the Continent, where it was found necessary to absorb part of the recuperated energy by means of resistances, because it was so largely in excess of the needs of the system that it left the generators unloaded and upset the regulation of speed—but the circumstances in that case were exceptional.

However, the fact remains that the merits of regenerative control have been proved to demonstration. Even where the route is not exceptionally hilly, energy is recovered in the act of retardation to a sufficient extent amply to justify the use of the system. The motors are no heavier than series motors—indeed, the same frames are used, shunt-wound instead of series—and the controllers are lighter and cheaper. The full-speed control is perfect, for it is automatic—thus embodying one of the advantages of the induction motor. The accelerating torque is greater—we repeat, it is *greater*—than that of the equivalent series motor. There is no trouble through sparking whatever. The car can be run at any desired speed, from walking pace to the full speed, with almost the maximum efficiency throughout.

In descending hills, the speed cannot become excessive, for the regenerative action automatically comes into play, and brakes the car just enough. The variations in the instantaneous power demand of each car, and, therefore, in the load on the power station, are greatly reduced. The load factor of the running plant is increased, and fewer sets need be run at one time. The line losses are for the same reason diminished. The wear and tear of brakes and wheels, and the cost of repairs to trucks, are reduced to an important extent. The passengers prefer—and actually select, where they have the opportunity—the regenerative cars, because there is less jolting when starting and stopping. We have not exhausted the list of advantages, but for the moment we must stay our hand.

We have in our possession absolutely independent written testimony to the merits of the system, as tried on the large scale, in direct comparison with ordinary cars of the same

weight and capacity, and running to the same schedule on the same road. We have other favourable evidence, also independent, and we have never received any reliable evidence to the contrary. This is not the first time that we have pointed out the advantages of the system.

Years ago we stood practically alone in insisting on the future supremacy of the overhead conductor at high pressure for electric traction on railways; more recently, we pinned our faith to the single-phase electric motor; and as our attitude in these two cases has been abundantly justified in the event, so now we believe that in strenuously advocating the adoption of shunt-wound motors for electric tramways, with the advantages of the regenerative system, we are pointing out the direction of future progress, and are acting in the best interests of the electric tramway industry.

The Electrical Heating of Metals.

In a recent number of the *Electrical World and Engineer*, Mr. Paul Hoho calls attention to the process he devised some 12 years ago for the electrical heating and working of metals. The process consists in heating a metal, quite locally if so desired, to a soldering, hardening, welding or fusing temperature by means of a direct current of electricity applied at any tension between 100 and 250 volts, the metal itself being always in contact with water. Mr. Hoho remarks that his process has not yet become much of a commercial success, because heat developed directly by the combustion of coal is in most places far cheaper than the same amount of heat developed indirectly therefrom by means of the dynamo; but he urges that the greater economy in transferring to an object the latent heat of an electric current in comparison with that accompanying the transference of heat from a solid, liquid or gaseous combustible, may often reduce the cost of heating a particular article electrically to or below the level of heating it in a metallurgical furnace. This is more particularly the case when strictly local heat is required. In a combustion furnace, the whole of any piece of metal must be raised to a considerable temperature before any one spot can be brought to the temperature necessary for the purpose in view; but in electrical heating, especially in the Hoho process, heat may be impressed upon the object so rapidly that conductivity and radiation have far less time to produce their usual effects. Moreover, as the heating takes place under water through the agency of a direct current, electrolytic action comes into play, and the metal is coated with a film of hydrogen, which protects it from oxidation, or reduces any oxide already present; so that even steels which are troublesome to solder in the ordinary way, can be soldered with ease. Another advantage claimed for the Hoho process is that it enables surface hardening to be performed satisfactorily. A rail, for instance, may have its wearing surface hardened without injuring the malleability and toughness of its interior. The heat is applied through a travelling conductor, two insulating shields being employed to localise the effect. When a certain portion has been raised to the requisite temperature, the conductor moves on to the next spot, and the former one is immediately quenched and hardened by contact with the water. Axles, wheels and the interior surface of cannon can, it is said, be locally hardened in a similar fashion. This form of the Hoho process has been on exhibition at Liége for the first time.

Electrical Trade in Canada.

Early in the present year we drew special attention to the electrical trade possibilities of Canada, and urged British manufacturers to see that this field was not neglected.

From information that reaches us from time to time, we are led to infer that considerable business is being done at present in Canada in central and distributing station equipment, and in certain responsible quarters the opinion is held that if British manufacturers were properly represented by competent and energetic men in Canada, a fair portion of this business could be secured for British factories. In the case of the lighting plant which is being installed by the town of Westmount, tenders were received from British manufacturers for the generators, and we understand on good authority that figures quoted by them compared very favourably with those submitted by Canadian and American firms. The contract for this apparatus will be awarded to builders in Canada, however, owing to the fact that in case of any breakdown or failure of the machinery it would be practically impossible to get defective or damaged parts back to the factory for necessary repairs without very great loss of time in the case of British machinery.

The Canadian General Electric Co., the Canadian Westinghouse Co. and the Allis-Chalmers-Bullock Co. are very active in the Canadian market.

These are all very large corporations with extensive workshops erected in Canada, and they are all adequately represented in the various business centres by staffs of employés continually on the lookout for any business which may be in the wind. It is an important question which should interest the British manufacturer whether or not it would pay to open up business in Canada with properly-equipped factories and sales departments.

A Significant Electric Locomotive Contract.

The ordering of 25 single-phase alternating-current locomotives from the Westinghouse Electric and Manufacturing Co. by the New York, New Haven and Hartford Railroad, is one of the most interesting recent events in the electric transportation world, for it signifies even more certainly than did the publication of the New York Central plans for improved terminal service some months ago, that the entering wedge of heavy electric traction on American steam railways is being driven home. Important as is the development of electrical suburban service in these days, the steam railway trunk lines have long been regarded as the ultimate prizes of the electrical engineer's developing triumphs, and it seems probable that the investment of the New Haven company in £150,000 worth of electric locomotives, marks the beginning of the end, as far as the steam locomotive is concerned.

The New York Central locomotives are well known to engineers as the largest direct-current machines thus far designed, weighing about 97 tons each, and capable of developing 3,000 H.P. for short periods. No steam locomotive thus far constructed, to the best of our knowledge, will develop anything like this amount of power, and the exhaustive tests which have in the past few months been carried on by the General Electric Co., at Schenectady, New York, show conclusively that the exacting work for which these enormous machines have been designed will be performed with brilliant success upon the completion of the terminal and trackage facilities at the American metropolis. The new locomotives purchased for the New Haven road will be capable of developing at least 1,600 H.P. at normal rating, and will each haul a 200-ton train at a schedule speed of 26 miles per hour in local service, with stops 2·2 miles apart, the maximum speed being 45 miles per hour. In express service a 250-ton train will be hauled at from 60 to 70 miles per hour. Although the momentary overload capacity of the four 700-H.P. motors on each locomotive has not yet been made public, it is

reasonable to anticipate a maximum output of at least 2,700 H.P. for brief intervals. In entering New York City the New Haven trains traverse the New York Central road's tracks south of Woodland, so the new single-phase locomotives will operate upon 600-volt direct-current circuits in the electrical zone of the latter road. This is a great point of advantage, and another is found in the use of the multiple unit system of control, which enables the locomotives to be bunched in cases where additional motive power is needed. The multiple unit system has only recently been adapted to alternating-current motor control, and without it the problem of heavy electric trunk line transportation would, in the light of present knowledge, be almost too difficult for solution, considering American train loads and grades, in the mountainous districts particularly. The choice of the single-phase system permits the enjoyment of the same advantages which the direct-current locomotive presents in suburban service—elimination of smoke, dirt and cinders, increase in traffic capacity, and probable reduction in operating expenses per passenger hauled; and it also enables long-distance trains to be handled without the heavy expense of frequent power and sub-stations, transmission and distributing circuits of large copper cross-section, rotary converters and high cost of attendance. Three-phase transmission at very high voltages is perfectly feasible, with reduction to about 3,000 volts at infrequent transformer stations, which means the easy extension of the electric system wherever the policy of the railroad declares it to be desirable. It is but a short time since a 75-H.P. single-phase commutating motor represented the largest available size on the market, and the jump to 400 H.P. in the gearless type is a triumph in design. It is interesting to recall the fact that the first important commercial experiments in electric traction under steam railroad conditions to be tried in America were carried out on the New Haven Road, and it is fitting that the same system should be the first to adopt on a large scale a locomotive capable of performing the requirements of trunk line through service. Although the new locomotives are to be used simply in the New York Central direct current zone at present, there is not the slightest doubt that the near future will witness an extension which will be the index of a far-reaching change in American steam railroad practice.

Electric Smelting in Canada.—As Canadian secretary of the Deep Waterways Commission, Mr. Thomas Cote has just completed a tour of several of the boundary points at which questions of international concern, bearing upon the utilisation of water powers and the cognate subject of navigation, have arisen in a form calling for joint action on the part of the Government of Canada and the United States. These points include Sault Ste. Marie, Rainy River and Niagara, and at each the sub-Committee, consisting of Mr. J. P. Maybee, chairman of the Canadian section; Mr. Clinton, of the U.S. section; and secretary, conducted the investigations necessary to enable them to report to the main commission. Apart from this, Mr. Cote naturally took a deep interest in the iron and steel situation, and especially in the prospects for successful operation of the electric thermal process of production, having been secretary of the Canadian Commission which, last year, investigated in Europe the various plants at which this process is employed. At the works of the Consolidated Lake Superior Co. at Sault Ste. Marie, an electric furnace is now being put up by Mr. Enystrom, of the mines branch of the Interior Department, the power for which is to be furnished free by the company. The plan adopted is that which the Commission investigated at Lapraz in France, and before many days the inventor of the process, Mr. Heroult, will arrive at the Soo to determine the completion of the furnaces and the test operations which are expected to determine whether, under the conditions prevailing, iron ore can be smelted in Canada by the electric process on a commercial basis. At the works at the Canadian "Soo," an exact comparison can be made of the cost of the two processes.

The immense iron and steel plant which the Canadian Northern is erecting at Port Arthur, also possesses a particular interest for Mr. Cote by reason of the possibilities of the location for the prosecution of electric smelting. Twenty-one miles from Port Arthur are the Kakabeca Falls, where by next summer electric energy to the value of 100,000 H.P. will be under development, the power company being under contract to supply the municipality of Port Arthur with electric energy for light and traction by next spring. With an abundant supply of good ore and the best of transportation facilities, the Canadian Northern works would also be in a rare position to utilise the power of the Kakabeca for electric smelting should the process prove a success.—*Montreal Gazette.*

HASTINGS ELECTRIC TRAMWAYS.

In our last issue we described and illustrated the Hastings tramways, and we now supplement the technical information there conveyed with some historical notes which may be found of interest.

In the year 1897 a system of tramways in Hastings was first promoted by the present company under the Light Railways Act, 1896. The scheme included tramways from Bexhill through St. Leonards along the Parade and a system of lines in Hastings itself, but not so extensive in character as those now constructed. Although this scheme was approved by the Corporation of Hastings, there was a considerable opposition on behalf of certain ratepayers; the main grounds for opposition apparently being that Hastings would suffer as a health resort by the introduction of electric tramways. The scheme was, therefore, rejected by the Light Railway Commissioners.

High Tide at the Queen's Hotel, Hastings.

In November, 1898, application was again made by the company to the Light Railway Commissioners for sanction to a scheme as far-reaching as that promoted in the previous year, but modified in regard to some of the routes.

In the same year the Corporation of Hastings, being desirous to own the tramways in the borough and to lease them to the company, to which arrangement the latter were agreeable, themselves promoted a Bill for tramways within the borough, which did not, however, include a line along the Parade. The British Electric Traction Co. also deposited a scheme, but limited to a tramway between Bexhill and St. Leonards.

A Heavy Sea at Hastings.

Owing to these two Bills being before Parliament, the consideration of the company's application was postponed by the Light Railway Commissioners pending the decision of Parliament in regard to both of these proposals. The Corporation's Bill was rejected on local opposition, and the Traction Co.'s Bill on the opposition of the L.B. and S.C. Railway.

The light railway scheme then came before the Commissioners for consideration, and although the bulk of the lines within the borough of Hastings failed to obtain their approval, sanction was given to the line between Bexhill and

St. Leonards, which was not opposed by the railway company, and an order was issued in the following year.

In 1899 the Hastings Tramways Co. again promoted a Bill for tramways in Hastings, but exclusive of lines along the Parade. This application was sanctioned by the Hastings Tramways Act of 1900, and the tramways now opened in Hastings have been constructed under the powers of that Act.

In the session of 1902 the company applied for a line along the Front, which was refused by Parliament on the opposition mainly of frontagers along the Front line. The application was again made for the Front line by the company in 1903; this application, though again opposed by certain frontagers, was passed by Parliament, but with two restrictions. First, that the line should not be constructed till the whole of the tramways authorised by the Act of 1900, and the whole of the light railways authorised by the order of the same year, had been completed, a representation having been made by the opposition that the company had no *bonâ-fide* intention to construct any line other than the line along the Front. The second restriction was that the line along the Front should be operated "by self-propelled cars or other system approved by the Corporation, not being the overhead system."

The company have now completed the whole of the tramways within the borough authorised by the Act of 1900, and the lines in Bexhill will shortly be completed; the construction of these lines having been much impeded by difficulties in land negotiations. They will not, of course, be able to commence the construction of the front line until the Bexhill lines are completed, owing to the restriction contained in the Act of 1903.

The company have endeavoured to obtain the consent of the Corporation to their making an application to Parliament for relief from the prohibitive clause as to overhead traction contained in the Act of 1903, as they feel satisfied that, apart from all financial questions in regard to extra cost of construction and operation involved in any system not being the overhead system, the convenience of the public will be far better met if the tramways are operated throughout on one system enabling all cars on all routes to be interchangeable and avoiding the necessity of passengers in some instances having to change cars, and in other instances the delay involved in changing from one method of electrical operation to another.

The conditions of the sea front at Hastings are such as to cause the company grave doubts as to the continuous reliability of any conduit or surface-contact system, and they find it difficult to appreciate the objection of the Corporation and of the frontagers to the overhead system.

The roadway on which the tramways will be laid on the Front is railed off from the promenade proper, and along the line of railings are lamp standards at present exist, not by any means attractive in design or appearance, belonging to the Corporation. The company is of opinion that if the tramways are laid close to the railings (the position most approved by the Corporation) and the lighting standards combined with the tramway standards, the difference from an aesthetic point of view of such combination, and the lighting standards themselves, would be hardly noticeable; bearing in mind the fact that, the tracks being laid close to the railing, the brackets could be extremely short and of an ornamental character, and that owing to the Parade being to all intents and purposes a straight line, no unsightly network of pull-off wires would be involved.

The company feel so strongly on this matter that they believe that if any system other than the overhead is adopted, it is only a matter of a comparatively short time before the Corporation are likely, in the interests of the travelling public, to apply to the company to change their system to that of the overhead, and the company are, naturally, averse to spending a considerable additional capital in exploiting a system which, in so short a period, it may be found desirable to supersede.

From our knowledge of the sea front at Hastings, we are in cordial agreement with the company's contentions on all points, and we reproduce two photographs of the front during heavy seas, which appear to offer sufficiently strong evidence, having in mind the experience of Blackpool, that the overhead system is the only method to adopt.

THE OLYMPIA ELECTRICAL EXHIBITION.

(*Continued from page 577.*)

Ozonair, Ltd.

The great value and manifest uses of ozone in the field of hygiene need no lengthy reference in these columns, but a machine to produce ozone on a commercial basis must be of the greatest value, and such a machine is that shown by Ozonair, Ltd.

Although substantially the same apparatus as that described in the Electrical Review of November 11th, 1904, it now embodies

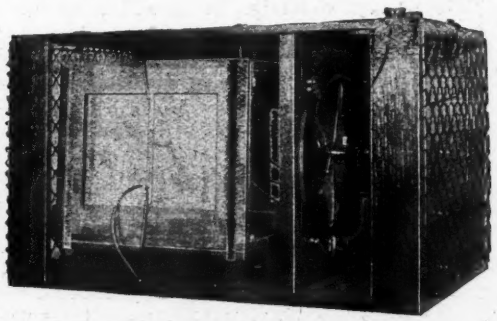


Fig. 76.—Ozoniser, showing Interior.

certain improvements. The apparatus is contained in an oak case, fitted with two self-locking doors, the opening of either of which cuts off the supply current automatically.

Internally, a high-tension transformer is arranged to electrify a series of gauze screens, through which a powerful fan, mounted at the rear of the case, propels the current of air to be ozonized.

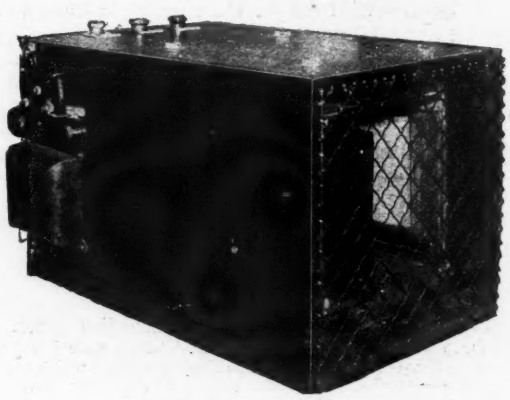


Fig. 77.—Ozoniser Complete.

Hinged guards are provided at either end of the machine, and the switches, cut-outs and plugs used for working the apparatus are fitted to the outside of the case, in convenient positions.

The machines are built in two sizes rated at 30,000 and 60,000 cb. ft. of air per hour; by the addition of a motor transformer they can be adapted for use with direct current.

The Fuller-Wenstrom Electrical Manufacturing Co.

This firm exhibits numerous alternating and continuous-current motors of the enclosed ventilated type. The alternating motors are of the short-circuited type with the exception of one slow speed single-phase motor. This type of motor is generally designed for low current density in rotor, so that an exceedingly light brush gear can be used, thereby avoiding complicated brush lifting and short-circuiting devices.

The stand is lighted by a small direct current generator, belt-driven, from a 2-h.p. single-phase motor of the short-circuited type, the starting current of which does not exceed 1¼ times that at full load.

The two and three-phase motors are of similar design to the single-phase. The starter consists of an auto-transformer for motors of the short-circuited type and of either a liquid resistance, or one with cast-iron grids for those with slip rings; the latter arrangement being suitable for speed regulation as well as starting. A liquid resistance for motors up to 30 h.p. is on view.

An item of considerable interest is a small converter which can be run as a d.c. generator, with an output of 12·5 amperes at 120 volts, or as a single-phase generator, giving 18·7 amperes at 80 volts, or as an inverted converter, with an output of 1½ kw. at a speed of 2,000 revolutions. The machine is designed to be as light as possible, and to have a good efficiency; it is therefore made with end shields of aluminium, and provided with ball bearings.

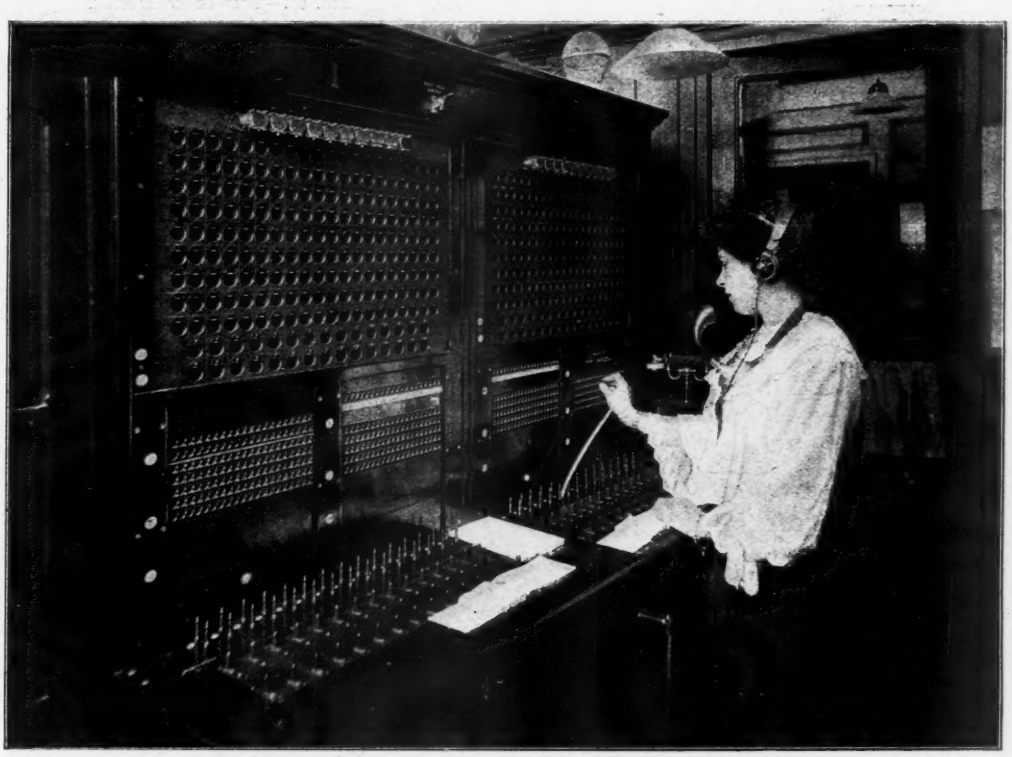
The efficiency curves of a two-phase 850-b.h.p. rolling mill motor

of the concatenated type are on view at this stand; this motor can be overloaded up to 2,250 H.P., and is designed to work at three different speeds, namely, 285, 235 and 200 r.p.m., with efficiencies of 93, 92 and 92 per cent. respectively.

It will readily be seen that this type of motor has an advantage in point of efficiency over those which are regulated solely by means of a resistance.

National Telephone Co., Ltd.

The exhibit of the National Telephone Co. is a going concern —an actual exchange, in connection with the telephone system of the whole country, and serving the needs of the exhibitors. The switchboard is of a special type, such as is fitted up by the company in various London and other hotels, &c.—in fact, we believe, it is practically identical with that which they have installed at De Keyser's Hotel. The maximum capacity of the switchboard is 800 subscribers; at the Exhibition, of course, only a portion of this is in use, there being 27 subscribers and 11 call offices about the building. There are 10 outgoing junctions to Holborn and 10 to Kensington, while there are 10 incoming junctions from the latter exchange. Visual signals are used, on the common battery system, and it is interesting to note that there is no battery at the



National Telephone Co.'s Hotel Exchange Switchboard.

Exhibition, all the current being derived from Kensington Exchange by means of 18 pairs of current wires and two pairs of ringing leads.

The distributing frame is of a novel type, dispensing with test jacks altogether; to make a test, a heat coil is removed, and the lines tested from this point, by means of a horse-shoe plug. The switchboard was supplied by the Western Electric Co., and wired by the National Telephone Co. The accompanying illustration shows the general appearance of a board practically identical with the one exhibited.

Besides this main exhibit, which is at all times a centre of interest to the general public, who watch the mysterious movements of the operators with absorbed admiration, the company shows a variety of telephones for internal intercommunication, &c., and a system of fire alarms.

The British L.M. Ericsson Manufacturing Co.

The Ericsson telephone has achieved a well-deserved popularity in connection with the National Telephone Co.'s extensive system. The company's stand contains a comprehensive display of switchboards and instruments for exchange and private use, military, portable and domestic telephones, and telephone accessories of all kinds.

Robertson Electric Lamps, Ltd.

Robertson ladies manipulating Robertson lamps are always an attractive feature at an exhibition, and at Olympia, no less than elsewhere.

The lamps, like the ladies, speak for themselves, and as some four millions are sold annually (lamps, not ladies), it only remains for the reader, in adding to that number, to learn their good qualities for himself.

I. Frankenburg & Sons, Ltd.

Cables for electric light and power, telephonic and telegraphic purposes, in the various stages of manufacture and finished, are shown by this firm, which also specialises in waterproof clothing for tramway and railway purposes.

Geipel & Lange.

This firm is showing on stand No. 29 a variety of apparatus, including Ward-Leonard rheostats, automatic motor starters, Geipel steam traps and separators, Vulcan meters and instruments, hour meters, Locke insulators, Okonite & Manson insulating tapes, nickel tubing, electric speed indicators, electric turn-down lamps, &c.

An interesting item is an improved pattern of fool-proof motor starter, the special feature of which is that it is fitted with an overload or maximum current circuit-breaker, which is so set as to open the circuit, on specially protected contacts, if the resistance is cut out too rapidly, thus preventing careless usage of the starter. A new form of no-voltage release is fitted, which is designed to be unaffected by variations in field strength, such as is common with variable speed motors; the no-voltage release coil is connected in series with a high resistance across the line, thus forming a true no-voltage release. A magnetic blow-out and entirely renewable contacts are now fitted to this type of switch, which is improved in every detail.

Some turn-down lamps shown on the stand are provided with two filaments, one for ordinary use and the other being a low C.P. filament. A switch is provided in the lamp cap for switching one or the other filament into circuit.

These lamps are stated to save up to 80 per cent. of current, and have been used extensively in the United States and Canada, in fact, the lamp received the highest and only award of its kind at the St. Louis Exposition.

The Frictionless Engine Packing Co., Ltd.

"Karmal" packing, "Roko" edge belting, and other specialities of value to the engineer, are shown by this firm.

Messrs. W. T. Henley's Telegraph Works Co., Ltd.

Messrs. Henley's have an extremely interesting exhibit representing practically every department of their activities. High and low pressure mains, insulated with vulcanised rubber, paper and jute, and destined for lighting, traction, telegraphs and telephones, are shown in bulk and sample, a pyramidal pile of cables on drums, surmounted and decorated with coloured lamps, occupying the centre of their stand. One of the cables is being supplied to the Underground Electric Railways and London United Tramways Companies, for a working pressure of 11,000 volts, the test pressure being 30,000 volts. This cable is of the 3-core type, paper-insulated and lead-covered, with galvanised iron armour laid direct on the lead.

Another interesting exhibit is a long-distance telephone cable for the G.P.O., consisting of 112 wires, each of which is insulated with paper and wrapped with a copper screening tape; an ordinary telephone cable for the G.P.O., containing 330 pairs, is also shown.

A number of feeder pillars for Stoke Newington are on the stand, with a variety of joint and disconnecting boxes; and house fuse boxes are represented by single-pole and other cut-outs of new patented design, in which improved terminals and dividing boxes have been employed, while arcking to the cast-iron case is prevented, and the fact that the fuse has blown is indicated visually.

A new form of terminal for concentric paper cables is illustrated herewith; in this device the outer conductor is tapped off at right angles, through the body of the porcelain insulator, while the inner

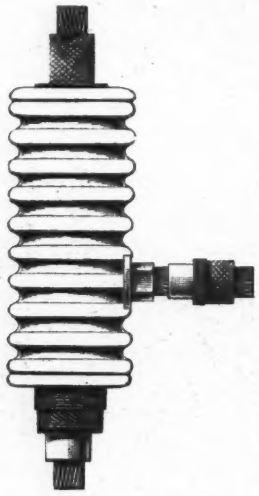


Fig. 79.—Terminal for Paper Cables.

continues straight through, the terminal being finally filled up with compound as usual.

Cables braided over-all with phosphor bronze and galvanised iron are exhibited, as well as samples of all kinds of cables, including submarine telegraphs and telephones, fire-resisting cables, insulating materials, house wires, flexible cords, &c.

Finally, mention must be made of a photograph showing the interior of a large extension to Messrs. Henley's works, which will be used chiefly for paper cables.

Monté-Callow & Co.

The exhibit of Messrs. Monte-Callow & Co. consists almost entirely of controller gear, much of it intended for rough workshop or colliery use. An endeavour has been made to combine the various elements of the controlling system in compact and "fool-proof" sets, while avoiding the introduction of expensive or delicate components.

One type exhibited takes the form of a motor-control panel on a column; the whole of the switchgear, ammeter and

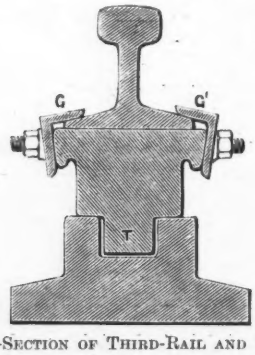


Fig. 80.—Section of Third-Rail and Insulator.

circuit-breaker are mounted on the panel, while the cables come up inside the column, and a separate liquid starting switch is interlocked electrically with the circuit-breaker, so that the latter cannot be closed unless the starting switch is in the off position. Such outfits are made for both direct and three-phase currents, and time-limit and no-volt releases can be provided. An ingenious type of resistance unit is used in connection with the starting switches, consisting of iron wire wound round (but insulated from) a stout iron core, which provides large capacity for heat, the whole being embedded in a cylindrical block of insulating material. A large three-phase 200-ampere 500-volt oil switch, suitable for use in collieries, and capable of being fitted as a circuit-breaker with time-limit overload release, is shown, together with three-phase enclosed oil-filled motor starting switches. A new form of ammeter for motor circuits figures largely on the various controllers; this is put forward as an instrument with an ample degree of accuracy for its purpose, combined with substantial construction to withstand rough usage, and can be supplied with a stout cast-iron case for exposed situations.

A heavy three-phase oil-filled reversing controller of the tramway type, for mining work, with horizontal axis, capable of dealing with 250 h.p., occupies one side of the stand, and there is a variety of switchgear, &c., of other types. The new "Opaline" non-hygroscopic insulating material for switchboard work, which was

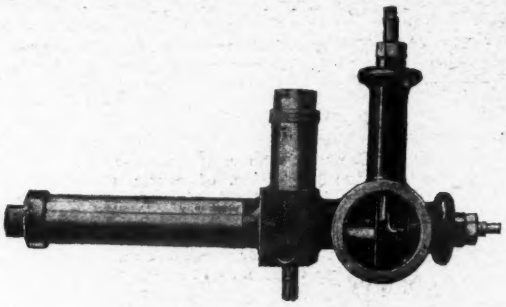


Fig. 81.—Time-Limit Device.

described at some length in our issue of February 24th, 1905, is shown, as well as glass steps, and a new type of third-rail insulator made of glass. The latter is illustrated herewith (fig. 80), and it will be seen that it has a cylindrical foot or dowel T, fitting loosely into a wooden chair, while the rail is firmly clamped to the top of the insulator at G, G^1. The idea is that when a loaded wheel runs over the adjacent track rail, depressing the sleeper, the latter shall be free to move with-

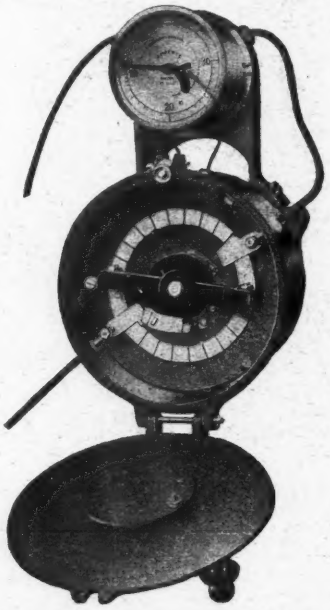


Fig. 82.—Motor Starter with Ammeter and Overload Release.

out affecting the insulator. With the ordinary type of insulator it sometimes happens that, owing to the rigidity of the third-rail, the insulator is torn in two under these conditions, and the new insulator is designed to obviate this danger.

Another illustration shows a combined motor starter with ammeter and overload release, while the remaining one, fig. 81, shows the latter device, which consists of a small attachment to the ammeter movement. It contains a pair of contacts in a chamber filled with glycerine, and a tube in which a metal ball is free to roll. When the normal load (to which the instrument can be adjusted) is exceeded, the ball begins slowly to roll down the tube, and if the overload is maintained, the ball, after a time depending upon the amount of the overload, strikes the contacts and closes the releasing circuit. In the event of a sudden violent overload, the contacts close instantly by gravity without waiting for the ball. The time limit can be set for any period from 3 to 60 minutes. Want of space forbids further reference to this interesting exhibit.

The British Accumulator Co., Ltd.

This company is exhibiting generally several types and descriptions of storage batteries for electric lighting and power purposes. The smaller types of cell are shown in glass boxes and the larger in lead-lined wood and solid lead alloy crate boxes.

A feature of the cell is the lead expansion feathers, fixed between the end negative plate and the side of the box, which keep all the plates firm and rigid. In all types of cells in glass boxes, the plates are suspended directly from the sides of the box, and in most cases the plates are burnt to the pole bars from cell to cell. The plates are of the large-surface Planté type, and are capable of dealing with very high and rapid discharges.

The Sturtevant Engineering Co.

This firm is showing a very comprehensive display of the well-known "Igranic" motor-starter and controlling switches and rheostats.

These motor starters are sufficiently well known to render a full description unnecessary, but of the array of automatic motor-starting appliances much might be said.

Among the many uses of these equipments, we may mention their application to pumps. In this case a float can be arranged to operate a switch, and energise a solenoid switch, thus completing the motor circuit and energising the solenoid spool of the self-starter. The motion of the self-starter is regulated by an oil dash-pot, which can be adjusted so that the contact lever moves over the

Fig. 83.—Sturtevant Self-Starting Switch.

contacts at a predetermined rate. As soon as the water level and float have risen to the desired level, the float switch circuit is broken with a snap, thus opening the circuit of the solenoid main switch and stopping the motor. Obviously an arrangement like this is very advantageous in any case where remote control of a motor is necessary, and where it is only desirable to run a pair of small leads of sufficient size to carry the fraction of an ampere necessary to energise the solenoid main switch, and for such purposes they have been largely used.

The company are specialists in lift control, and they exhibit two distinct types of automatic lift controllers, viz., their rope operated

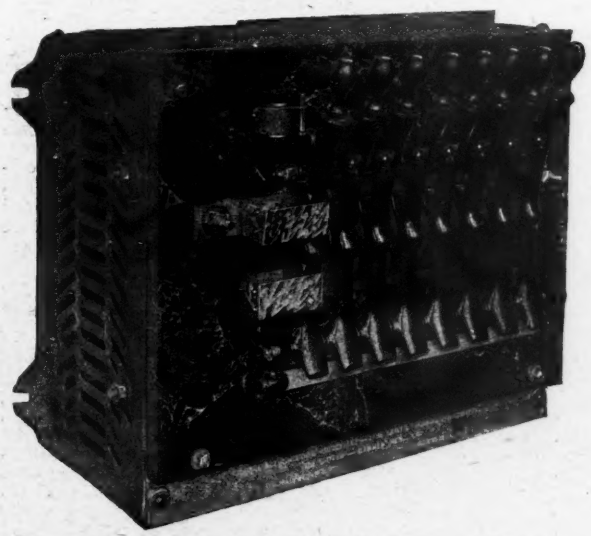


Fig. 84.—Sturtevant Multiple Switch Starting Rheostat.

lift controller and their car switch operated lift controller. The rope operated lift controller is exceedingly simple to install; the rheostat, solenoid controlled main switch and reversing switch, are all mounted so as to form a single piece of apparatus. On pulling the rope the reversing switch is moved round, and the motor circuit made by means of the solenoid main switch; an automatic magnetic device then releases the rheostat lever, allowing it to fall against the resistance of an air dashpot, and slowly cutting out resistance, until the motor attains full speed. To stop the lift, the rope is pulled in the other direction, bringing the reversing switch arm back to the off position. The circuit is always made and broken by the solenoid main switch, which is fitted with a carbon break and magnetic blow-outs.

The car switch operated lift controller shown on the stand is also very simple in action. Starting, stopping, and reversing the motor are all effected by the operation of a neat switch in the car, which, as in the case of the float switch, only actuates auxiliary circuits, the motor circuit being controlled by solenoid operated switches on the controller, fitted with the usual carbon break and magnetic blow-outs.

Another feature of the exhibit is the "Igranic" machine tool controllers, by which a speed regulation of 4 to 1 can be obtained by inserting resistance in series with the shunt field alone. These

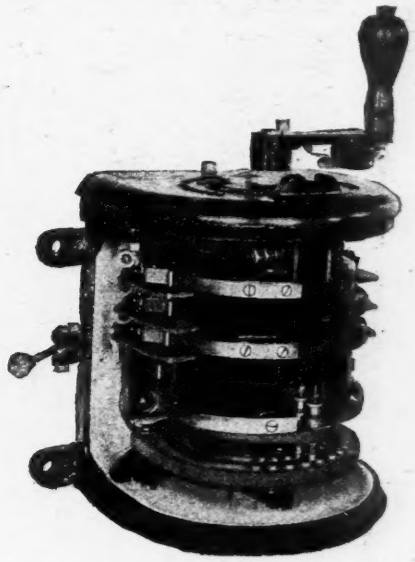


Fig. 85.—Sturtevant Car Switch for Lift Controllers.

are of two types, the well-known drum pattern and the slate front pattern; they can be provided either for reversing or non-reversing motors.

An arrangement peculiar to this firm is the multiple switch starting rheostat, which consists essentially of a number of switches mounted on the slate front of a resistance box. To start the motor, the operator first pushes up the left hand lever, which makes the motor circuit with all resistance in series with the armature, and is held up by engaging with the loose armature of the no-volt release coil. Successive levers are put in until all the resistance is cut out of the armature circuit, the levers being interlocked so that it is impossible to put in any except the first, without first putting in the lever on the left hand side of it. This arrangement is specially suitable for starting up motors having very heavy starting currents.

A. P. Lundberg.

As a manufacturer of electric light accessories, Mr. A. P. Lundberg, of Pioneer Electrical Works, Liverpool Road, London, N., has been with us for a great many years. We ourselves remember his specialities since—well, quite the early days of electric lighting, when the demand for such accessories as tumbler switches, wall

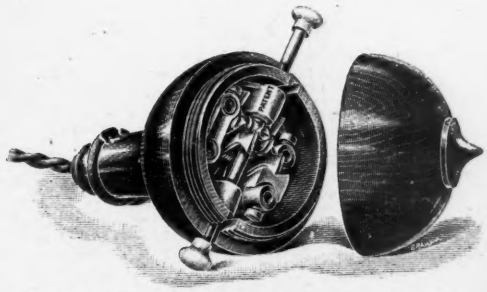


Fig. 86.—Two-way See-Saw Suspension Switch.

plugs, and so on, first began to be. There has always been something new and ingenious issuing from these works, and the output of things new and interesting is now as great as ever. A call at the Lundberg stand will soon convince the visitor how true this statement is. He has a multitudinous collection of devices of very varied descriptions exhibited, but the demands upon our space are

so heavy, that we can only show a few in passing. The caller will observe two large boards fitted with branch switches, showing the various adaptations of "Pivot" two-way, intermediate, combination types, series parallel and "off," three-way, &c., tumbler switches, all the wiring for them being on the surface, without a single joint, it being on the "looping-in" system. Architects, consulting engineers and wiring contractors, as well as wiremen and students could spend time profitably here, as they show many new specimens. Mr. Lundberg also shows the "Sun and Planet" advertising device (patent applied for), which is a novelty for

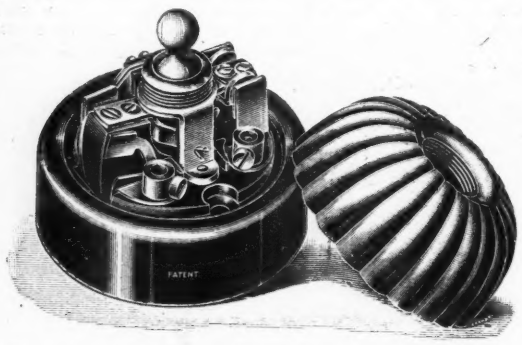


Fig. 87.—Series-Parallel and "Off" Tumbler Switch.

advertising purposes and is worked by magnetic agency; as a shop window or exhibition attraction it is claimed to be very effective. There are several new patterns in "Dot" and "Universal" wall connections which have not been seen before. The "Duplex" two-way and "off" tumbler switch we have already noticed in our columns. All standard patterns are brought up to date and include various improvements in construction.

We illustrate in fig. 86 the patent two-way patent see-saw suspension type switch; in fig. 87 a series parallel and "off" (whole or part circuit "off") tumbler switch. Fig. 88 illustrates the "M. I. P." patent ceiling rose which is quite a novelty, and at

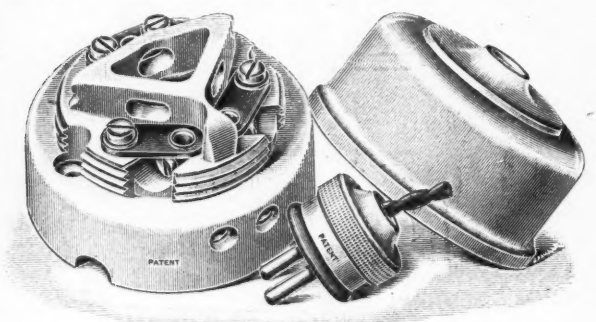


Fig. 88.—"M.I.P." Ceiling Rose.

Olympia it is shown adapted in 17 ways. The arrangement of detachable plug and terminals allows this versatility where an ordinary ceiling rose has but a limited application. Mr. Lundberg has recently issued a number of new catalogues detailing most of the above and many other special lines. In his last issued list, "Special Tumbler Switches," every type shown is a new one.

A. P. Wright & Co.

Messrs. Wright specialise in country house lighting, and on their stand are showing specimens of oil-engine and dynamo and fan combinations, supplied by Messrs. Wade & Jones, Ltd., of Birmingham, whom they represent, and apparently well suited for the purposes intended.

The Hart Manufacturing Co.

As an innovation of considerable practical utility, this company's "Diamond H" switches are well worth close inspection; the firm's rotary switch, both single and double-pole, for operating electroliers in sections, is also a handy contrivance. The Midland Hotel,

Fig. 89.—Hart Tramcar Switch.

Manchester, the Gaiety, and the new Ritz Hotels in London, have installed this firm's switches, which fact speaks for itself. We illustrate a quick on-and-off 500-volt tramcar switch, which has been adopted by the L.C.C.

The Bat Electrical Co.

Although it is somewhat late in the day, we would emphasise the advantage to central station engineers of a special visit to the Bat stand, to investigate the R. F. permutator.

This handy machine has already an excellent reputation on the Continent, and given a wider appreciation of its virtues, its adoption in this country will rapidly follow. The two machines on view are of 3 and 5 kw. capacity respectively, built by the Egyptian Electrical Co., Paris, and are running off the 50-cycle single-phase Exhibition mains. They resemble in design the three larger units described in our article on the Liége exhibits (Electrical Review, September 29th, 1905). The alternating current is led to the primary winding of a stationary transformer or armature, forming part of the permutator, the secondary winding of which is connected to a fixed commutator, on which a set of brushes is forced to revolve at the synchronous speed of the current induced in the secondary winding. Slip rings are fitted on the rotary brush-holders, and stationary brushes resting on these rings serve to convey the direct current to the outgoing terminals of the machine. The brush-holders are attached to an internal rotor, which is provided with a short-circuited winding, and rotates with the alternating rotary field; the brush gear automatically attains synchronous speed in a few seconds, and the speed is, of course, independent of load variations.

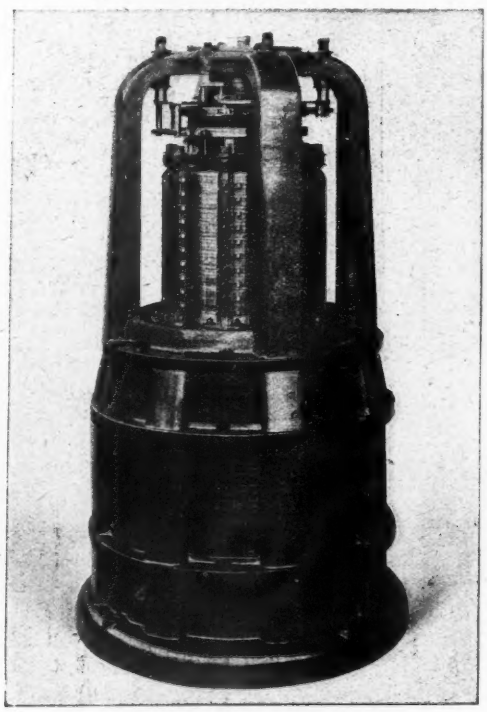


Fig. 90.—R. F. Permutator.

We illustrate the machine in fig. 89; its simplicity and economy in operation are features which gained for it the Grand Diplome d'Honneur at the Liége Exhibition.

Although overshadowed by the above, the Bat Co.'s stand contains other matters of interest, including the Bat meters and Bordon arc lamps, which it may be noted are running on rectified current supplied by the R. F. permutators.

Rumney & Rumney.

A special feature of this stand is being furnished by the Auto Controller and Switch Co., for whom the firm are London agents.

The patent auto lift and hoist controllers for operation by means of hand ropes running through the cage of the car, as manufactured by the above firm, are of two types:—One has for its distinguishing feature the cutting out of the resistance mechanically by means of a belt drive from the motor shaft and in the other, the resistance is cut out magnetically by means of a specially designed solenoid.

One of the chief advantages of the first type is that the cutting-out of the resistance being dependent on the rotation of the motor, it is impossible for this operation to start until the motor starts to rotate, and it is, of course, impossible for the resistance to remain out after the motor has stopped; the motor cannot be reversed without first bringing into circuit all the resistance. In this controller, as in all controllers for a similar purpose made by the Auto Controller and Switch Co., the inductive kick upon stopping, which occurs in the windings of the motor when ordinary controllers are used, has been entirely eliminated. Another point is the "braking" of the armature of the motor magnetically; as this action is applied at the circumference of the armature, the torsional stress to which the armature shaft is subjected when the brake is applied while the armature is still being urged forward

after the current has been cut off, is avoided. Electric lift or hoist controllers for operation by means of a switch in the car or cage are on view, as also is the patent "push-button" controlling apparatus for use both on alternating and continuous current circuits, by means of which the occupant of the car has sole control of its movements.

A considerable space is devoted to measuring instruments of Johnson & Phillips's well-known types, and the Bastian specialities in electrolytic meters and mercury vapour lamps of various types are prominent, the latter in the lighting of the stand.

The Churton single-phase repulsion motor is a serviceable machine on view at this stand. This motor is of the induction-repulsion type adapted for direct coupling to hoisting machinery and other purposes for which a high starting torque is required. The construction of the motor is similar to that of the ordinary single-phase induction motor with a wound rotor, and a commutator in addition to the usual slip-rings.

The standard motors are usually wound for six or eight poles, there being six or eight lines of short-circuited brushes to the commutator.

When the motor is started up, the starting resistance is in circuit with the rotor windings, and the machine runs as a repulsion motor. As the starting resistance is cut out, the action of the motor approaches more and more closely to that of the induction motor.

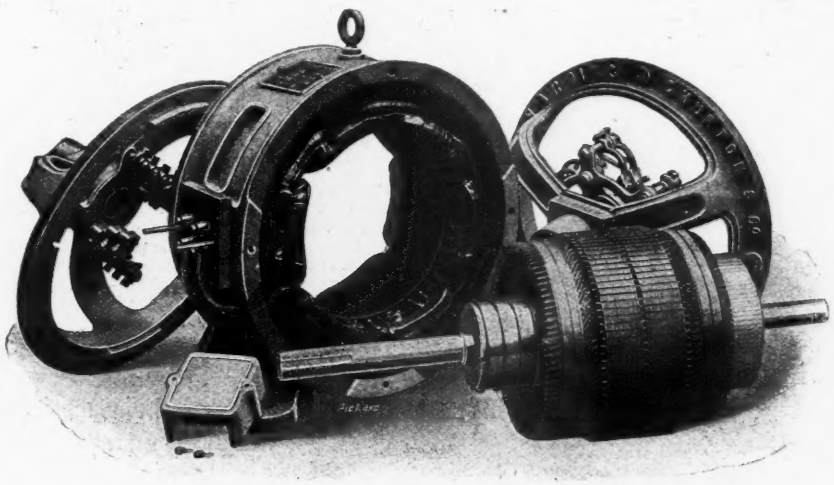


Fig. 91.—Parts of Churton S.P. Repulsion Motor.

With this type of motor the starting torque due to the repulsion effect is greatest at the moment of starting, and falls off as the motor gains speed. On the other hand, the torque due to the induction effect is least at starting, and increases up to full load speed. The resultant effect is that the initial torque gradually falls to full load torque at full load speed.

With a starting current equal to 1½ times full load current, this motor will give a starting torque of about 1¾ times normal full load torque. The starting torque may be increased up to three times full-load torque, with a starting current equal to twice full-load current. For reversing puposes, the stator is provided with

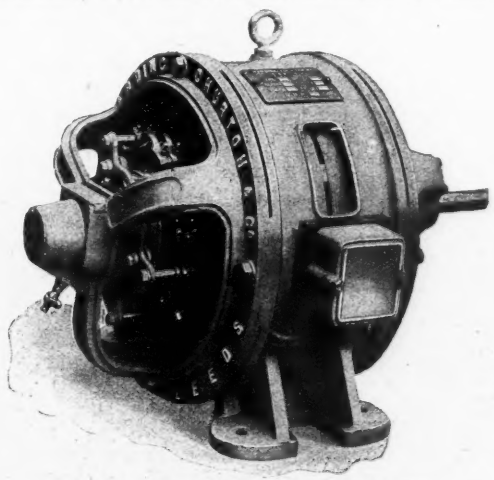


Fig. 92.—Churton S.P. Repulsion Motor.

two windings which are interleaved in a special manner and so arranged as to give the maximum starting torque in either direction by means of an ordinary two-way switch, no movement of the brushes being necessary. Sparking at the commutator has been prevented by keeping the self-induction of the rotor as low as possible, and by dividing the commutator into a large number of parts, &c.

Owing to the very high starting torque obtained with these machines, the acceleration against load is, of course, rapid, which is an important matter for working lifts. It should also be added that the motor runs up to speed and works very quietly.

The efficiency of this motor is particularly high and, being well ventilated, the machine is also well adapted to continuous running on full load.

Falk, Stadelmann & Co., Ltd.

This firm gives a very attractive and comprehensive display of many things required in connection with the commercial and domestic applications of electricity. In regard to fittings, while exploiting especially the commercial types, of which figs. 93 and 94 are representative examples, due prominence is given to the classical schools. Several excellent types—correct in detail—are submitted in the Georgian, Louis, Empire and Adams periods, while examples of the range of statuary in Faience recently introduced by the company are also to be seen, together with a variety of their latest models in bronze. A novelty which naturally proves a centre of attraction is a fountain, standing about 4 ft. high, in real bronze

Fig. 93.

with coloured jewelled insets. A circular stream of water is thrown up from the centre while jets stream from the mouths of two griffins reclining on the outer framework. This is operated, of course, by an electric motor, which is contained in the upper part of the structure. When lighted the effect is very striking.

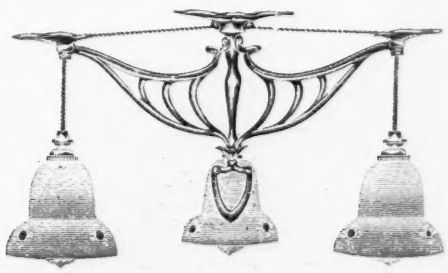


Fig. 94.

A part of the stand is reserved to accessories which, while covering the familiar and every-day articles, embrace a number of specialities, amongst which may be mentioned the "Celerophone," an improved "direct working" micro-telephone, the "Hercules" and "Reliance" patent alarm bells, the former for battery working, and the latter for direct connection to continuous current circuits;

the Atlas indicator (mechanical replacement), the construction of the locking attachment of which is claimed to be such that the movement cannot shake down, no matter how much vibration there is; the "Semaphore" indicating patent push, which enables the sender of an electric signal to assure himself of its receipt; the "ampere" cell (central zinc) which, having no porous pot, reduces the internal resistance to a minimum; the "Climax" system of steel interior conduits, &c.

The company is also showing types of its new range of glow-lamp radiators. For the stand itself the scheme of colouring is white and gold, the interior being in terra cotta with art green panels.

Edison & Swan United Electric Light Co., Ltd.

The great attractions at this company's stands—and they rank among the most popular items at the Exhibition, when one considers it from the point of view of the general public—are the telautograph, shown in operation,* and the charming company of incandescent lamp makers at their various interesting occupations. Of the former, from the technical point of view, there is nothing new to say, but it ought to be mentioned that it is being manufactured entirely at the Ediswan Works at Ponder's End; and of the latter, what need is there to say anything?

This exhibit holds one of the most prominent positions in the centre of the hall. It is divided into three sections, one for lamp exhibits, another for engineering items, and a central reception room, in which are shown various articles, mention of some of which is made below. The company's numerous specialities in lamps, including the well-known Radiolite lamp (fig. 95), and an exhibit of historical lamps, showing the progress of inventions and earliest examples in the history of lamp making, are shown in the first section. In the engineering section are exhibited the various manufactures of the company, such as traction, ship, factory and

Fig. 94.—Ediswan Candle Fitting.

colliery fittings, hand lamps, ceiling roses, switches, &c. A prominent exhibit is that of measuring instruments (fig. 96) manufactured by the company. By the way, this department has now been taken up by the company in real earnest, and the excellent finish and general appearance of some of the specimens shown merit very high praise. Their latest improved form of moving-coil type is prominent. Amongst other things there are exhibited bells, indicators, pushes, batteries, while the latest patterns of fuseboards, distribution boards and switchboards also hold an important position. In fact, there is a complete exhibit, illustrating electricity as applied to house and general lighting, heating and ventilating. The latest examples of electric lighting accessories, holders, cut-outs, &c., are shown, and also machines at works actually producing them.

The central reception room contains some examples of the company's latest patterns in artistic electric fittings (fig. 94) and electric fans of various types; electric radiators are also displayed. The company is also making an exhibit in this room of the latest applications of electricity as applied to medical science.

We must not omit, in noticing the Ediswan stand, to refer to a very attractive souvenir which they are very freely distributing

Fig. 95.

Fig. 96.

among visitors who reach their part of the Hall. It is entitled "The Birth and History of the Royal Ediswan Lamp," and, when the public go away from the fascinating scene of busy Ponder's End girls making glow lamps, they will turn the pages of this book with great interest and read every word voraciously. To familiarise the public with such stories and such processes as are written about in this souvenir is to help electrical progress forward; in that way the Olympian Exhibition is doing great good.

Nalder Bros. & Thompson, Ltd.

Messrs. Nalder Bros. & Thompson have on view at their stand an excellent collection of electrical instruments of all types, and some fine examples of switchgear.

The instruments are adapted for central station work, in which, indeed, experience has proved their great value.

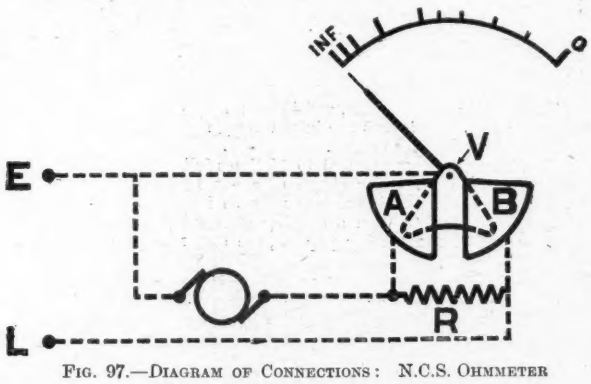


Fig. 97.—Diagram of Connections: N.C.S. Ohmmeter and Generator.

A sector-shaped station voltmeter of the illuminated dial type provided with a scale over 20 in. long is a prominent feature, and would, doubtless, be equally prominent to wandering switchboard attendants in a generating station. The N.C.S. wattmeter, constructed under Dr. Drysdale's patents and described by us in connection with the Tramway Exhibition, and numerous portable, recording and high-tension instruments add to the interest of the stand.

An instrument well worth close scrutiny is the N.C.S. ohmmeter and generator. This consists of a generator and electrostatic ohmmeter combined in one polished wood case, which we illustrate on p. 623.

With regard to the generator, special attention has been given to details, and it embodies all the latest improvements. The handle is of the free type, so that damage cannot be done to the teeth by pulling the handle up somewhat suddenly. It is provided with carbon brushes, and special care has been taken in the design and construction of the commutator, so that the wear on this is practically nil. These generators are not being made with a lower voltage than 500, as for ordinary testing purposes it is better to use a fairly high pressure; they can be made to give as high a pressure as 1,200 volts direct current.

The ohmmeter is of the electrostatic type, and consists of a vertical needle with 13 parallel vanes, about ·3 of an inch apart. These work into sets of fixed inductors of specially calculated shape. This instrument, being electrostatic, is of course independent

* For description, see Electrical Review, November 16th, 1900.

of all external fields, and also can be made much lighter than any other form of instrument.

The generator has one of its terminals attached directly to one quadrant, A, fig. 97, of the electrostatic ohmmeter and the same terminal attached through a resistance, R (which is wound on porcelain insulators, and contained in the case of the instrument) to the other quadrant, B, of the ohmmeter. The other terminal of the generator is connected to the vane, V. In actual practice, however, four sets of inductors are used, the opposite pairs being connected together. The quadrant, B, is attached to the line to be tested and the vane, V, is attached to earth. When the insulation resistance between

Fig. 98.—N.C.S. Ohmmeter and Generator.

the earth and line is infinite, there is no current flowing through the resistance, R, and the vane, V, takes up the position shown in the diagram. When a current flows from E to L there is a drop of potential due to the current flowing through R, the quadrants A and B are then at different potentials, and the vane, V, takes up a new position, which is determined by the difference of potential and the shape of the vane. The vane, V, is shaped approximately as shown, so as to be in stable equilibrium at all parts of the scale. The weight of the instrument complete in case is 13¾ lb.

Portable Accumulators, Ltd.

A comprehensive display of portable accumulators for many purposes is shown by this firm. The batteries are mostly adapted

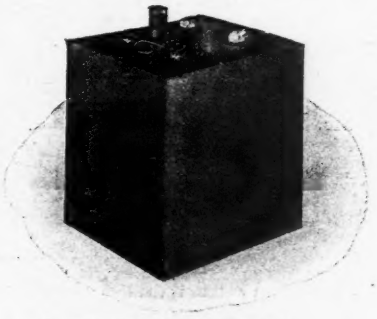


Fig. 99.—Ignition Cells.

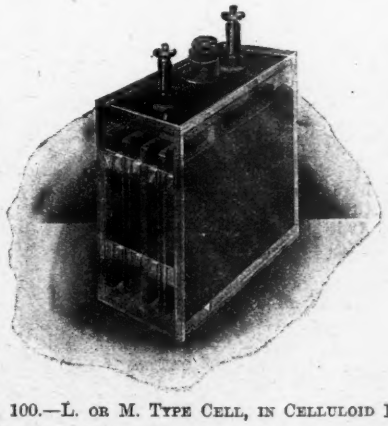


Fig. 100.—L. or M. Type Cell, in Celluloid Box.

for small work, but include plant for train lighting, boat driving, &c. Various instruments suitable for measuring and testing with the above cells are also on view.

The British Prometheus Co., Ltd.

This company is showing a variety of artistic appliances adapted for heating, cooking, &c.

Convectors or heating stoves in pleasing designs are specially prominent; we illustrate herewith a hand-beaten copper convector, of antique finish and decorated with repoussé work, which fully upholds the excellent reputation of the firm for this class of work.

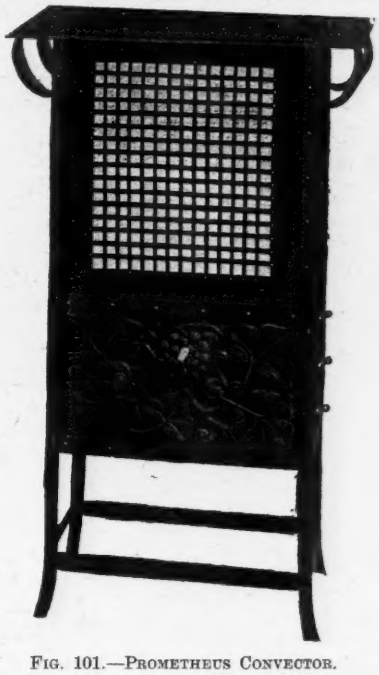


Fig. 101.—Prometheus Convector.

The company makes a speciality of ships' convectors, of which a number were supplied for the use of the Prince and Princess of Wales on board H.M.S. *Renown*.

An electric bakery was also fitted on this ship, two large "Prometheus" baking ovens being installed. We also understand that the *Amerika*, now on its first voyage across the Atlantic, has been fitted up with similar heating appliances.

Frank Pearn & Co., Ltd.

Messrs. Pearn's speciality is pumps, and their exhibit is typical of the industry which they have so long and well represented. Donkey, wall and double-ram pumps, motor-driven single and triple ram pumps, together with patterns adapted for boiler feeding and pit sinking will be found on their stand.

The Lister Electric Manufacturing Co.

Dynamos and motors, with their accessories, form the staple product of this company. Their exhibit includes a Sisson-Lister 40-kw., 460-volt steam generating set, and a 100-kw., 440-volt standard multipolar generator for belt driving; a group of electric

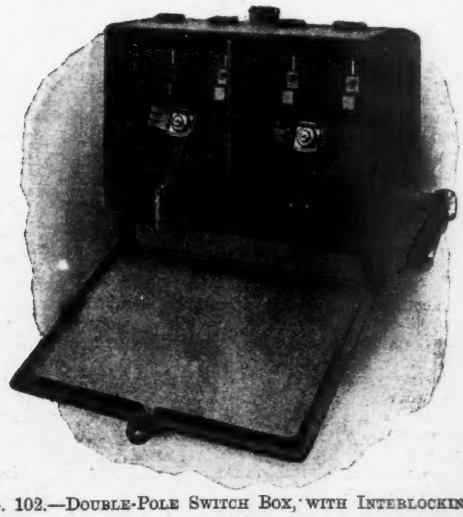


Fig. 102.—Double-Pole Switch Box, with Interlocking Handle.

motors ranging from ½ to 120 b.h.p., of which some are fitted with ball bearings, and others are combined with various forms of reduction gear, for special application to driving. Attention is

directed to the sound construction of these machines, and several loose armatures in which absolutely non-hygroscopic insulation is employed are at hand for inspection.

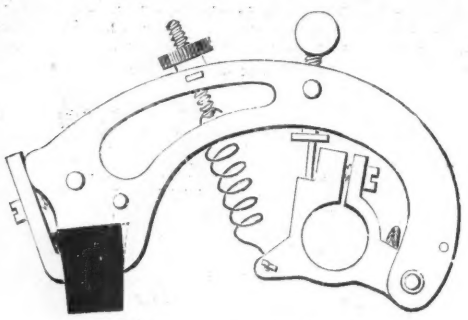


Fig. 103.—New Brush-Holder.

Among the accessories is a new type of brush-holder, in which the brush can be taken out from the front while the machine is running. This we illustrate; it is adaptable for various sizes of carbon, and is fitted with a hold-off catch and safety stop to prevent the holder from dropping on to the commutator in case of accident.

A new and simple motor-starter at this stand deserves special notice. In this the contact passes over a series of platinoid contact

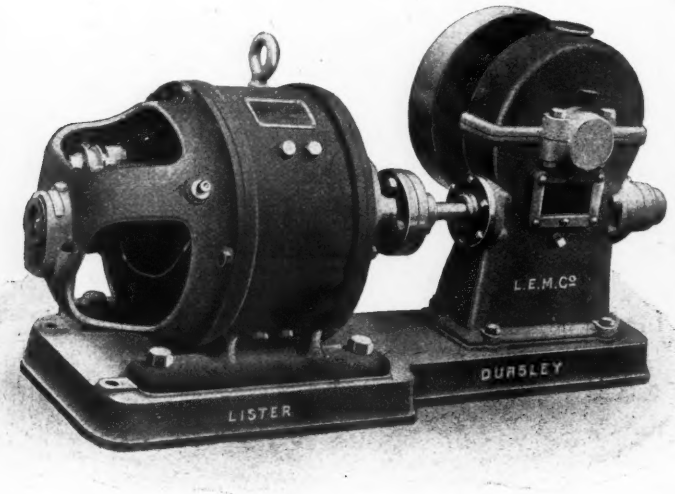


Fig. 104.—Lister Motor and Speed Reducing Gear.

plates arranged on the front of the switch. The movement is sparkless, and the arrangement dispenses with the usual helical coils.

Switch accessories in considerable variety are also on view, and attention may be drawn to the firm's design of double-pole switches and fuses in cast-iron boxes, the lids of which can only be opened one at a time, and then only when the locking switches are off (fig. 102, p. 623).

Dr. Heinr. Traun & Sons.

The comprehensive exhibit which has been arranged by Mr. F. Winter, the manager of the London agency of the above-named firm, includes representative samples of ebonite products for use in every branch of electrical engineering, and some other industries, too. The firm is proud of having introduced the principle of interchangeability of parts into the manufacture of ebonite, in telephone work, for instance; beautiful examples of accurate moulding are shown, for terminal boards, telephone jack strips, &c. For the construction of Bell receivers for the G.P.O., which are notoriously liable to fracture, the standard of strength which must be passed by the ebonite has been raised 25 per cent. by the improvements effected by Messrs. Traun & Sons. In the case of induction coils, for which the very highest quality of ebonite must be employed in order to withstand the stress due to the high voltage, every tube is tested and provided with a certificate as to its qualities.

As illustrating the remarkable properties of ebonite, we may mention two very large tubes which are exhibited; one of these was tested at the Reichsanstalt, and successfully withstood a pressure of 50,000 volts per millimetre of thickness. The dielectric resistance was $2{,}000 \times 10^6$ megohms per cm^3, and the material, which was about $\frac{3}{4}$ in. thick, was tested with a spark 40 in. long without perforation.

It is a curious fact that, whereas 1½ to 2 millions of the firm's "Buckle" insulators are in use for tramway overhead equipment on the Continent, they are almost unknown here. These and other tramway fittings are covered with "Griffin" material, which, as we have personally verified, possesses astonishing strength, and adheres to the steel cores with extraordinary tenacity.

Bushes, &c., of great strength and heat-resisting properties, switch handles vulcanised to steel and wooden spindles, railway signal bobbins, battery boxes, and many other accessories in ebonite are shown. Over 1,700 different moulds are kept for storage cells, thanks to the penchant of the inventor to think of the box after everything else is designed, and to require a new mould for his own exclusive use. A large stock of ebonite of all descriptions is kept in London.

The International Electric Co.

The I.E.C. refrain from showing anything but the very latest construction of telephone equipment, fire alarm and signalling apparatus. Their exhibit has, therefore, been attracting not only a large number of sightseers, but practical engineers as well, whose attention is not riveted by highly polished terminals, but who are in the habit of scrutinising an apparatus.

A common battery telephone switchboard with glow lamps, having a capacity of 24,000 subscribers in the multiple field, is shown in working order. It embodies modern practice in telephone

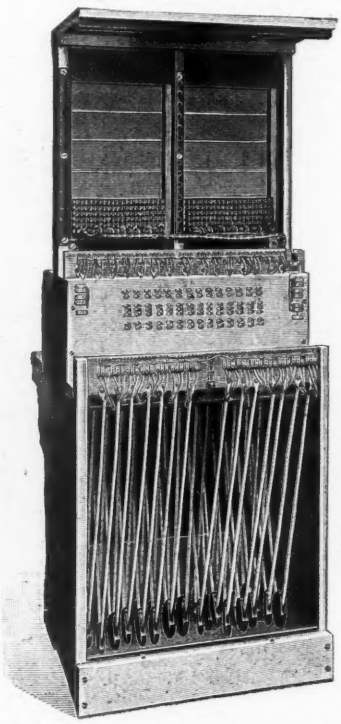


Fig. 105.—Back View of Multiple Switchboard.

exchange work, and numerous protective appliances, both for exchange and subscribers' use (H.V. guards, heat coils, lightning protectors, &c.).

A fire alarm installation, built up with compound generators and compound polarised bells, is highly instructive. No matter whether the line breaks down or is earthed, it is claimed that the alarm can be given just as well as if the line were intact.

The company demonstrate their ability to cater, not only for everyday requirements in the telephone line, but also for specialities, such as military, naval and mining purposes, by the long range of apparatus suitable for these varied branches. A special panel of their show is set apart for their watt-hour and ampere-hour electricity meters for direct current, alternate current and three-phase, the two former being connected to the respective supplies at the Exhibition. The company's meters have been adopted for numerous central stations in the United Kingdom.

The accompanying figure (No. 105) shows a back view of a multiple switchboard.

D. H. Bonnella & Son, Ltd.

This firm's specialities in non-inflammable imitation ivory and tortoiseshell have attracted considerable attention, as providing an obvious substitute for celluloid, in the manufacture of switch fronts, &c. Artistic flush switch and push fronts, a new brush contact switch, patent shadeless candle lamps, in which all the parts are renewable, and illuminating signs in which multi-coloured and prismatic effects are obtained, are also objects of interest to which we may direct attention.

McPhail and Simpson's Dry Steam Patents Co., Ltd.

The necessity of a superheater is gradually being recognised by the majority of steam engine users, and the latter cannot do better than inspect the above firm's very interesting display of apparatus at Olympia. Several types of superheater are shown, and the specimen tubes, which have stood 10 years' night and day use in a Babcock & Wilcox water-tube boiler with temperature up to 700° F., will go far to ease the qualms of those who hesitate on the score of safety.

Electrical Power Storage Co., Ltd.

E.P.S. cells, of the firm's well-known patterns for central station and kindred uses are most prominent on this stall: the engineer

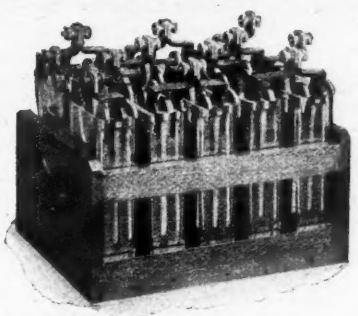


Fig. 106.—E.P.S. Experimental Battery.

does not require reminding of their good qualities. An attractive feature of the stand is a motor-generator set of Electromotors' make,

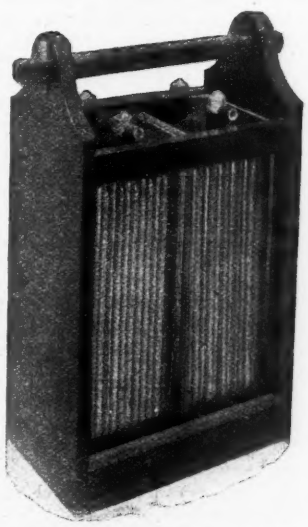


Fig. 107.—E.P.S. Laboratory Cell.

running off the exhibition mains and charging E.P.S. cells. The company is specialising in laboratory batteries, examples of which

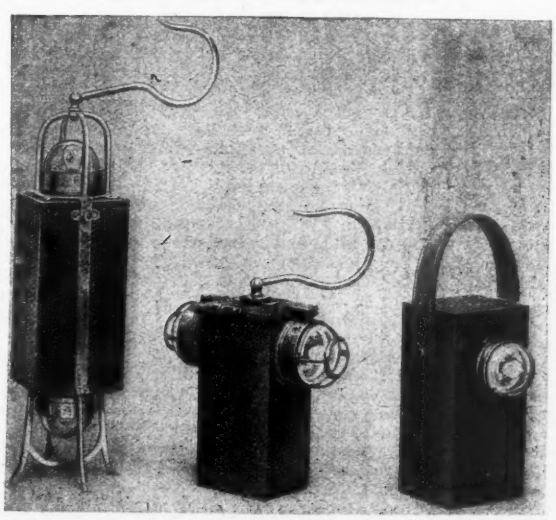


Fig. 108.—E.P.S. Miner's and Hand Lamps.

we illustrate, together with a handy form of miners' or hand safety lamp, also a product of the company.

Linolite.

The Electrical Exhibition may be said to mark the arrival of "Linolite" at maturity. It is in use for the lighting of no fewer than 16 stands, as well as the Café Chantant (where it is employed both for the footlights and in a float), and it is a significant fact that several firms adopted it after they had seen the effect obtained with Linolite at other stands. The Electrical Review stand is illuminated with Linolite, which has given every satisfaction. Needless to say, the Linolite Co.'s stand is profusely embellished with their speciality, which is also used to spell out the name of the firm in effective lines of light. With the ordinary patterns our readers are familiar; the accompanying illustrations show a new

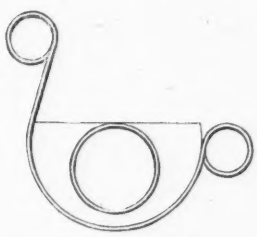


Fig. 109.—Special Section of Linolite for Picture Lighting.

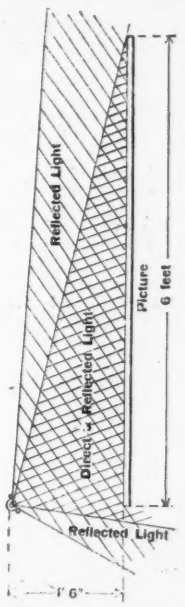


Fig. 110.—Method of Lighting Pictures with Linolite.

type, which has been brought out specially for the lighting of pictures. The section illustrated is capable of illuminating a picture 6 ft. high, and the great advantage of lighting from below as shown is that in the case of glazed oil paintings, in which the reflections from the glass usually render it impossible to see the picture properly, the Linolite system renders the glass absolutely invisible. This fact is demonstrated on the stand.

But little Linolite will have been observed about the Exhibition; this is where it suffers from the defects of its qualities—for it is precisely in its unobtrusiveness, combined with efficient illumination, that it excels. Thanks to the correct observance of scientific principles in its design, Linolite advertises other things whilst modestly effacing itself.

Arc Lamps, Ltd.

The Davy patent arc lamp can be seen and admired on this company's stand, in all its many patterns. Fourteen of the firm's lamps are employed in the lighting of the stand, and numerous examples of photo-printing and inverted lamps are also on view. The firm's twin carbon lamps, of which some 700 to 800 have been installed in Cardiff, form a prominent feature of the exhibit.

D. P. Battery Co., Ltd.

Four types of storage batteries are shown on the D. P. Co.'s stand—the "Lumford Station," "Lumford Heavy," "Lumford Light" and "Strip" types. In each case parts are shown formed and unformed, with sections of the plates, and discharge curves. The stand is arranged with a view to exhibiting each of these four patterns distinctly and separately, with excellent results. Concerning the merits of the D. P. battery there is no need to speak; but we may mention that the makers pride themselves on the excellence of their lead burning, and certainly the workmanship exemplified by the burning of the lugs exhibited is unexcelled by that of any other cell shown. Large clearance spaces are provided at the bottom of the cells, so that it is never necessary to clean them out throughout their life.

The largest cell shown—the largest, it is claimed, in the Exhibition—is one of 11,000 ampere-hours' capacity, at the 10-hour rate, and 5,500 for one hour. The plates are in sections, joined at the centre, and supported at three points. Another interesting item is a positive section which has been in use for five years, doing hard work, and is practically as good as new. Two of the actual cells now being supplied to the Bath Corporation, "Lumford Station" type, of 1,540 ampere-hours' capacity, are also shown.

The Phœnix Dynamo Manufacturing Co., Ltd.

This company provides an interesting exhibit embracing alternating and direct-current machinery; the direct-current generators and motors are fitted with the company's system of auxiliary field poles (Phœnix-Pohl patents), designed to give perfect commutation and high overload capacity (see Electrical Review, March 24th, 1905).

A P.D.M. variable speed motor, with an output of 3½ B.H.P. at any speed between 425 and 1,800 r.p.m., is on view. The regulation is entirely by shunt resistance, and the machine is absolutely sparkless at all speeds with full load; it will, moreover, carry a 50 per cent. overload at any speed for a short period. The company has been very successful with its products, and the opportunity of closely inspecting the stand should not be missed.

"Sunlite" Reflectors.

The Sun Electrical Co., Ltd., of Charing Cross Road, W.C., in their new "Sunlite" reflector list, have enlarged the range and scope of these fittings, and several new designs are now being offered. In fig. 111 we show a specimen section of the "Sunlite" lineal reflectors, Nos. 4 and 5 types, with two lamps to each foot. This has been designed for use with ordinary B.C. lamps, and where the space occupied by the reflector is not of the first consideration. The advantage of being able to use ordinary lamps is obvious, while from the slightly increased dimensions of the reflector, the effective range of reflection and radiation is given a much wider scope. With No. 4 either 5-C.P. ordinary bulb, or 8-C.P. and 16-C.P. No. 3 bulb can be used. With No. 5 any ordinary B.C. lamp up to 32 C.P. can be fitted.

Fig. 112 shows the No. 6 "Sunlite," with five lamps per 2 ft. run. This forms a powerful reflector, and is, perhaps, the most effective of the series. The angles of the reflector and the lamps are so arranged that a brilliant flood of light is directed forward and sideways, and diffused over a very large area. It is specially suitable

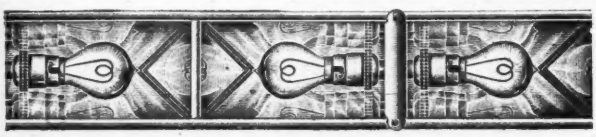


Fig. 111.—Nos. 4 and 5 "Sunlite" Reflectors.

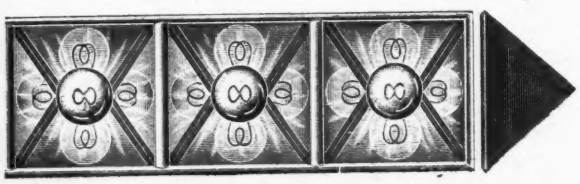


Fig. 112.—No. 6 "Sunlite."

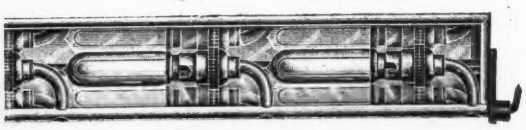


Fig. 113.—No. 7 "Sunlite."

Fig. 114.—No. 7 "Sunlite" Open for Cleaning.

for large windows and showrooms, also for rail lighting in picture galleries. Ordinary B.C. lamps can be used, and the reflector can be supplied in any continuous length up to 10 ft.

Fig. 113 shows the latest pattern in use, No. 7. Fig. 114 shows the lamps and holders removed for cleaning. This has been specially designed to overcome the cleaning difficulty. The principle of the construction is novel. The metal case is the one used in the Sun No. 1 series, but there are no joint boxes or divisions. The mirror plate is in continuous lengths from end to end; one of the usual side bends is replaced by a nickeled tube, on which are mounted small angle brackets carrying the lampholders and lamps. This tube is so constructed that the whole of the lampholders and lamps can be quite easily removed from the reflector, and the mirror can be cleaned from end to end by a single sweep of a duster, the lamps taken out and cleaned, and the whole replaced in a few seconds. The wires are inserted in the tube which carries the brackets, and the electrical connections are simple and straightforward. There are no bare wires, brushes or clips to get out of order.

This company's exhibit is situated in the annexe, and an attractive show is made of the various types of reflectors alluded to above. Many other specialities are also displayed, including flexible arm bracket fittings, a spring shade holder, artistic shell fittings, and so on.

The "Resilta" Co.

The "Resilta" Co., of West Drayton, Middlesex, are showing a first-class English-made insulating paint and an armature baking varnish. They are also showing lines of enamels in all colours for house decoration, bath enamels and damp-resisting paints. We understand that the insulating paint and armature baking varnish, which are of the greatest interest to our immediate readers, have recently been subjected to special tests, with excellent results. This firm also make anti-sulphuric enamels, which are very effective in appearance and finish. The London agents for these products of the Resilta Co. are Messrs. Thomas L. Scott & Co., of 3, London Wall Buildings, E.C.

The Albion Lamp Co.

An interesting stand is that of the "Albion Lamp Works" who have an attractive display of incandescent lamps. Although a comparatively new lamp on the market, it is claimed for the Albion lamp that it is already coming into favour on account of its high efficiency and illuminating power.

These lamps which are made by the Albion Lamp Works, and shown by Messrs. Godden & Co., of 20, Moorgate Street, the Albion Co.'s agents, are English made throughout from point to cap.

G. Straus & Co., Ltd.

A selection of various accessories for electric lighting and other purposes is shown by this firm, including switches (the auto-claw and other types), electric bells, brackets, lamps, wires and cables. A special line of junction boxes is in evidence, also a portable coupled petrol electric set, consisting of a 4-H.P. "Fafnir" petrol engine and dynamo.

The Brush Electrical Engineering Co., Ltd.

Prominent among the large firms exhibiting at Olympia is the above company, whose exhibit, comprehensive though it is, scarcely does justice to the well-known products of the firm. A 500-KW. transformer for the County of Durham Electric Power Co., and an example of the Birtley-Falcon coal-cutter, manufactured by this company, are prominent features, while Brush motors and controllers, together with a radial tramway truck, add to the attractions of the stand.

(To be continued.)

THE NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION.

A general meeting of members of this Association was held at Olympia on Monday afternoon, to which an invitation had been extended to a number of exhibitors, in the hope of increasing the membership.

Mr. W. Davenport (secretary) was, as usual, elected to the chair. He said that they were there to report progress. They had not yet got in all the members of the old Association, but they had secured a good many new ones. They hoped that the Exhibition would bring in more, as it was seen that they had been working for the general good of manufacturers. They had invited exhibitors in order for them to see how the Association did its work. When they could get in all manufacturers of any particular article, they could sectionise their subject so as to give more attention to their interests.

Local Exhibitions.

Mr. Berry (Berry, Skinner & Co.) introduced the first matter that was down for consideration—viz., local exhibitions, and the attitude the Association ought to adopt in regard thereto. He said that they ought to put their foot down firmly, and say that they could not assist at minor exhibitions. To get over this difficulty without hindering the industry, it was suggested that in cases where they were approached by councils outside—and even inside—London, the manufacturers should agree, if necessary, to only send exhibits to such shows when the whole of the expense was borne by the council interested in such exhibitions. It would be incumbent upon the promoters of such exhibitions to pay carriage on goods both ways, and to return them in the good condition in which they were sent out.

Mr. Justus Eck (Union Electric Co., Ltd.) referred to the constant cadging of some central station engineers, who asked for material to be sent down to fill their showrooms. The success of the Olympian Exhibition seemed to him to show that it was desirable to have local exhibitions in large centres of industry, such as Birmingham and Manchester.

Mr. F. B. O. Hawes (Langdon-Davies Motor Co., Ltd.) supported Mr. Berry's proposal, but he asked whether they had any means of getting Corporations to carry out that idea. If the Association became strong enough they would have power to compel it, but it would be rather unsafe for them to say they would not exhibit until they were in that position.

Mr. F. H. Nalder (Nalder Bros. & Thompson, Ltd.) thought the case would be met if they could get members of the Association to say they would not exhibit at any exhibitions excepting those arranged by the Manufacturers' Association.

Mr. C. S. Northcote (Veritys, Ltd.) said that the borough engineer of Exeter and his Committee had canvassed very hard indeed with a view to getting support for a local exhibition. He (Mr. Northcote) told them that he was perfectly certain the Committee of the Association would not give its support. Exeter had withdrawn its exhibition scheme as a profit-making one, and it would hold an exhibition at its own expense if the manufacturers would lend the goods. He thought that if the trade were unanimous they could

put a stop to what was a grievance, by undertaking only to lend stuff at the promoters' own expense.

Mr. H. Bevis (General Electric Co., Ltd.) said it was not their wish in any way to stop local exhibitions, but it was hardly fair that the manufacturers should bear the expense of this sort of thing as they had done in the past. Their wish was to help to promote the industry generally. If the local people wished to have an exhibition, the manufacturers were all quite willing to assist them by loaning the goods as long as they were free of expense. Then they were doing all that they should be asked to do.

The meeting then voted unanimously in support of the *modus operandi* of the committee in this matter.

Railway Rates.

Mr. F. H. Nalder said that very little further had been done in regard to railway rates, but there was one question to mention, namely, the difference between the relative rates to Birmingham and Manchester. The rates to Birmingham were relatively very much heavier than those to Manchester. It was proposed to form a committee to deal with this matter, and they would like to have co-operation.

Insurance Expert.

The Chairman said that the committee wanted to consult the meeting as to the appointment of an insurance expert to the manufacturing trade on lines which Mr. Bevis would explain.

Mr. Bevis said that some years ago central stations were a great deal harassed by the insurance rates which were charged; the rates had become more reasonable now, but he found on looking into the question of insurance that if they had a little expert advice they could make very material saving in the rates at which insurance companies assessed them. Insurance business was not unlike railway procedure. They had a tariff rate, and if one of the companies said that a certain figure was the rate, the others all had to fall in line, but some of the offices were fairly strong, and were not in the tariff circle, and that fact had a beneficial effect. With some manufacturers who had large stakes in works, stocks, &c., the question of insurance was a most vital one, and the difference in saving between 10s. and 7s. 6d. per cent. came to quite an important amount. He had had to go into the matter, and had made a very considerable saving. He would never have achieved his purpose if he had not had a man who was able to advise him. If he could get that benefit he thought they, as an association, ought to be able to do so too. Their aim was to keep the money in the electrical industry, and not send it outside. It would be a good plan to have this expert—especially as he charged them nothing. Provided the Association saw their way, he would be very willing to act in the same way for any of their members. He did not do it for nothing; he got his advantage not from them but from the insurance companies, and it was a case of no result no pay. At present if they applied for insurance the reply was, it is so much and they had to take it or leave it, unless they had the advice of an expert. They might be doing something in their works which they should not do, because it was a dangerous risk and raised rates. The insurance people did not tell them that, they only said that the rate was so much. The expert, however, would say, "If you take that out I can save you so much." In his own case, in one of his works it would pay him to take out a particular industry and put it somewhere else. If they had an expert he could probably point out to them how they could reduce their risk.

Mr. I. B. Birnbaum (Sterling Telephone and Electric Co.) proposed that such an expert be appointed to deal with insurances on the basis stated by Mr. Bevis. Mr. Marshall seconded, and it was carried.

Christmas Boxes.

Mr. H. Oppenheimer (International Electric Co.) said that the trade was unanimous in its desire to save money on Christmas boxes, but it was not sufficient merely for a certain number to agree to abstain from giving them. The beanfeast circular of the Association had been a success, and the principle there applied would apply also, but in a larger degree, to Christmas boxes. They wanted to do away with that institution as far as possible. There were Christmas boxes and Christmas boxes. They did not aim at the friendly gift between friend and friend, but they were aiming to stop wholesale robbery or blackmail. Christmas boxes in certain forms were a nuisance. The question was how far would the Committee be justified in taking united steps. Unless they found that there was some really unanimous expression of opinion they would not be able to proceed successfully.

Mr. Douglas Bate (Electric and Ordnance Accessories Co., Ltd.) said he thought they were unanimous in feeling that Christmas boxes should be done away with. He suggested that the secretary should be empowered to issue at an early date a circular, a number of copies of which could be sent to every member for his use.

Mr. Birnbaum said that he would like a cure for this sort of thing if he thought that they would all go through the same cure honestly. Christmas boxes were a part of business competition.

Mr. Lundberg said that there must be an absolute agreement as to where they stood. He would like to propose that they had an agreement, or did nothing at all.

The Chairman thought that was too drastic a measure at present.

Mr. Bate moved "that the members of the Association agree that they will not give Christmas boxes, and that circulars be sent out to that effect."

Mr. H. W. Butler (Electrical Power Storage Co., Ltd.) having expressed his willingness to sign an agreement, it was suggested that the chairman should obtain the consensus of opinion on the subject.

Mr. G. Sutton (W. T. Henley's Telegraph Works Co., Ltd.) said that there should be a clear distinction made between beanfeast and Christmas-box beggars. For the former there was no excuse—for in such a case they gave to the wrong people; but Christmas-boxes were given willingly to the men to whom they wanted to give them. There were cases where Christmas boxes should be given—for instance, to certain men who had nothing to do with the placing of orders, men who went out of their way to do one little services. Presents to such were in no sense a bribe. He had on his books for Christmas boxes people with whom they did no business at all—men who had retired, for instance. It was very difficult to make distinctions when making a rule of that sort. Though looking at the matter generally, it was better to make a hard and fast line, it would come very hard in the case of those friendly gifts.

Mr. C. S. Northcote said that if they could not come to a consensus of opinion as to exclusive stopping, they could not do any harm to allow the association circular to be sent out to the effect that they had agreed not to distribute Christmas boxes. He agreed with Mr. Sutton regarding friendly gifts, but it was the onerous application for a present that should be dealt with by answering with that circular.

Mr. E. J. Clark (Hart Accumulator Co., Ltd.) thought an agreement would be no good at all. They ought to take one another's word.

When is the Next Exhibition to Take Place?

Mr. Grainger (Sunbeam Lamp Co.) introduced this topic. There might be a desire, as Olympia had been a success, to repeat it. Some had suggested another exhibition next year. Whilst the committee felt that it would be very unwise to have another exhibition at so early a date, they felt it would also be unwise to settle any definite date for any future exhibition—national as the present one. This exhibition was proposed by the Association in the first instance, and was held under its auspices, and it was felt that the question of another exhibition had better be left, and as soon as the desire was expressed that it should be held, the proposal would come before the Association again.

After a few words from Messrs. Northcote and Bevis on the point, Mr. Grainger formally moved "that this meeting of the members of the National Electrical Association of Manufacturers will not exhibit except at an exhibition under the auspices of this Association."

Mr. Birnbaum seconded, and it was carried unanimously.

The N.E.M.A. Dinner at Olympia.

On Monday last the National Electrical Manufacturers' Association gave a pleasant little dinner at Olympia to a few of their friends interested in the electrical industry. The usual loyal toasts having been honoured, Mr. J. E. Edgcome proposed the toast of "Success to the Association." He remarked on the sameness of aim of the station engineers and manufacturers, namely, to make money, except that the station engineer endeavours to make money for his corporation or company, while the manufacturer tries to make it for himself. Mr. C. S. Northcote, in response, reviewed the origin of the Exhibition, and concluded by asking for the National Electrical Manufacturers' Association the further support of the trade.

Mr. David Smith then proposed the toast, "Success to the Exhibition," and said it required no words of his to make it a success—it was a success, the Press declared it so, and the public pronounced it a success, but seeing that the Exhibition was nearly at an end it was rather like meeting a friend after a long journey and wishing him "bon voyage." It was late in the day to wish the Exhibition success, but not too late to wish it "Continued Success," coupling with the toast the names of Mr. Albion T. Snell and Mr. L. G. C. Russell.

Mr. Snell, in responding, recalled the various electrical exhibitions which had preceded that now being held, and said he considered the feature in the latter consisted in improvements in detail, and that there was much there which to the ordinary consumer was new. The flame arc lamp, he said, had upset all our standards of lighting, and prophesied that shortly nearly all our streets would be lighted by flame arc lamps. He then mentioned the mercury vapour lamps of Cooper-Hewitt and of Bastian for indoor lighting, and went on to consider the metallic filament lamps, tantalum and osmium, &c., respecting which he foretold probable considerable improvements.

The toast of "The Guests and Visitors" having been proposed by Mr. Herbert W. Berry, and responded to by Mr. Sydney W. Baynes, Mr. E. Cunliffe Owen proposed "The Chairman" (Mr. Walter Davenport). He said secretaries generally took a seat at the bottom of the table, but it showed what an excellent secretary Mr. Davenport was when they found him at the top table. "He is," he said, "your guide, philosopher and friend." He then expressed the hope that the Manufacturers' Association would be the means of bringing all concerned closer together.

Mr. Davenport replied in eloquent terms, referring to the good feeling existing between the members of the Association, and hoping that the company would meet again at an early date.

LEGAL.

Brockie-Pell Arc Lamp Co. *v.* Pinkerton.

In the Shoredith County Court, on Thursday last week, before his Honour Judge Smyly, K.C., the adjourned case of the Brockie-Pell Arc Lamp Co., Ltd., *v.* G. M. Pinkerton, was heard. The plaintiffs carry on business at 60, Worship Street, E.C., and the defendant at 6, Lloyd's Avenue, E.C., as a lamp dealer. Plaintiffs claimed £7 5s. for electric arc lamps supplied on behalf of the defendant to Messrs. Lilley & Skinner, boot dealers, of High Holborn. The defendant denied giving the order in the way

suggested, and alternatively if it was given it was only for a few repairs, and not for arc lamps. His Honour adjourned the case for the production of book proofs that the work was done.

His Honour: Have you any proof as to who gave the order?

Mr. Lawsen (for the plaintiffs): I do not think it is disputed.

His Honour: Oh, yes, it was; it was said that the order was given by the defendant's predecessor, and I have here a letter from Messrs. Lilley & Skinner, in which they say distinctly that they gave the order to the defendant's predecessor, Mr. Coborn.

Mr. Lawsen: But the defendant rang through on the telephone and asked when the work was going to be completed.

His Honour: That is nothing at all if he did not give the order. Mr. Coborn has gone to America. How does it stand with regard to the account; who is to draw the money from Messrs. Lilley and Skinner?

Defendant: Well, at present I cannot draw the money, as it is impossible for me to charge a matter of about £9 for cleaning four arc lamps.

His Honour: But how would it have been if the order had been given direct to Mr. Pinkerton?

Defendant: I would have done it myself, and it would not have cost as much as that.

Mr. Green, secretary to the plaintiff company, said that he received the order on the telephone from Mr. Pinkerton. Mr. Coborn, when in business in Sackville Street, did not have a telephone.

His Honour: I must say that this charge seems very high for cleaning four lamps. Was there any estimate of any kind sent? It certainly seems to me that it is a most unreasonable charge; in fact, it seems to me to be a tremendous amount. I cannot deal with such a matter. I know nothing of the cost of this kind of work, and I think the only way will be to refer it to an expert.

Mr. Lawsen: Will you please fix it at some reduced amount to save the cost of an expert.

Defendant: Messrs. Lilley & Skinner refuse to pay for the lamps, as they say the work has not been done properly.

His Honour: And I am not an expert. I cannot say one way or the other. Such a case as this should certainly be referred to an expert. I cannot be supposed to understand electricity. So far as I can see, if £1 a lamp is paid it seems ample. Such an order as this, when taken over the telephone, should be confirmed with regard to price, as it is ridiculous to suppose that a person can run the chance of what is going to be charged for such work.

Mr. Lawsen: I would suggest anything rather than the cost of experts to decide this question; might I say £5 for the work as it has been done?

His Honour: You seem afraid of the electrical expert.

Mr. Lawsen: Not at all; only it would be a great expense, and there would be nothing left for anybody.

A gentleman named Griffiths was called, and stated that the charge as made was the usual charge made by the firm for such work.

His Honour: Then all I can say is, that it seems very high. I will give judgement for £5 and costs, and I think that is quite ample.

Hammersmith Borough Council *v.* Mulholland.

An action, which concerned the electric light supplied to Mr. J. B. Mulholland, proprietor of the King's Theatre, Hammersmith Road, by the Hammersmith Borough Council, was brought before Sir William Selfe at the Brompton County Court on Friday.

Mr. Hill, counsel for the Borough Council, plaintiffs in the action, said that his clients' claim for electricity supplied to the defendant, for a period lasting from May 25th to July 31st, 1903, had been reduced by mutual agreement from £80 10s. 6d. to £52 17s. 3d. This reduction had been made necessary by the fact that the first amount was arrived at from the reading of a faulty meter.

Mr. Munroe, for the defence, said that Mr. Mulholland was counter-claiming for £152 odd in respect of his loss of receipts by reason of the plaintiffs' failure to provide a continuous supply of electric current, in respect of extra lime light which had to be provided, and of additional work which had to be done on account of plaintiffs' failure to install their motor-generator at the time specified.

Mr. Bell, electrical engineer to the Hammersmith Borough Council, said that the local authority agreed to supply electric current to Mr. Mulholland at the King's Theatre, when that place was in course of erection. The Council only supplied alternating current, but they agreed to have a generator installed whereby the alternating current could be converted into continuous current for the defendant's purposes. The defendant had continued to use the Council's electric current ever since, but he had not paid the account in which the mistake had been made.

On the counterclaim, Mr. Hill submitted that there was no contract to supply continuous current before December 1st, 1903, and that therefore there had been no breach, and defendant had suffered no loss at the Council's hands; and, secondly, that the case came under the Public Authorities Protection Act, and in consequence any redress that the defendant had should have been sought in the police court directly the Council had failed to carry out their public duty. Mr. Hill also submitted that the Court had no jurisdiction to deal with a counterclaim of over £50, considering the date of the Act he had quoted.

Mr. Hawke argued that this view of the case was totally incorrect. As a matter of fact, the Council were not bound to supply the defendant with alternating and continuous current, but "jumped" at the opportunity of doing so, because they knew he would pay them about £700 a year. The matter had not, from the commencement, been dealt with in a business-like way, as it would have been had it been in the hands of a private firm. When the trouble over the motor-generator—supplied by an outside firm for use at the King's Theatre—arose, the Council had written letters to the poor, unfortunate contractor, breathing "fire and slaughter," and had actually received an indemnity, but when a ratepayer complained because he had been put to great loss and annoyance, he was to be told that he could not recover under contract law.

The Judge suggested that since a point had been raised concerning his jurisdiction, the parties might possibly come to some arrangement.

A consultation was held, and counsel announced that an agreement had been come to; claim and counterclaim would be withdrawn, and the parties would pay their own costs.

Judge Selfe: Since litigation is expensive, that is the happiest way out of the difficulty.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Some Arithmetical Questions for Mr. Byng.

May I be permitted to say a few words in reply to the letters of "Veritas" and "Anti-Humbug" appearing in this week's Review. I think the time has now come for Mr. Byng to be relieved of some of the burden he has taken on his own shoulders, and to receive more active assistance from British manufacturers in his crusade on behalf of British trade. We all know that the business of the G.E.C. was built up mainly by the free import of foreign manufactured material; but nobody can dispute the fact that the G.E.C. have done their best to encourage British manufacturers from the first, drawing their stock from different makers in this country as much as they possibly could, at a time when English manufacturers were years behind their foreign competitors in the manufacture of electrical accessories, especially in designs of the small varieties. I think that manufacturers owe a debt of gratitude to Mr. Byng for his fight on behalf of British manufacturing.

There no longer exists any excuse for the purchaser of foreign manufactured materials, as the British manufacturer has reasserted himself, and, given equal conditions, can more than compete in the home market with the foreign manufacturers; but equal conditions must exist, and if we are not to have a tariff to assist in bringing about this desirable condition, we must adopt other methods.

I notice in the Review that the London County Council have passed over the Hungarian works estimate of £38,200, and accepted a British tender of £63,525, with a notice that the foreigners *were not prepared to accept the Council's labour conditions;* and yet we encourage the foreign manufacturers at the expense of our own manufacturers, our workmen, their homes, wives and children, by purchasing goods made under conditions of labour which would not be allowed in this country. If the imported articles had to be made under the conditions of labour compulsory in this country, we should see very little of them. But we must combine to fight the foreign manufacturer, who competes against us successfully in our own markets simply because there is no law in the countries where these things are made restricting the sweating of men, women and children, which is considered by the foreign manufacturer as perfectly justified; we occasionally get glimpses of what this means when reports of the same labour conditions employed by foreign manufacturers in Whitechapel appear in our own papers.

I do not know Mr. Byng, "Veritas," "Anti-Humbug," or any of the others, but I was one of the first to advise the formation of a Contractors' Union; this has done a great deal of good, but would be of little use in this matter, although later on it could be of great assistance. I now suggest the formation of an Institute of Electrical Manufacturers, not for the purpose of fixing prices or controlling prices in any way, each manufacturer being absolutely free, but for the purpose of carrying on an active campaign in the Press in favour of British manufacturers, and giving lectures in different parts of the kingdom to bring home to thoughtless people the evil done by purchasing foreign materials that can be obtained from English manufacturers.

Manufacturers, belonging to the Institute or not, should be kept acquainted with the latest design in machinery, and where machinery can be obtained equally as good in this country as abroad, architects and consulting engineers should be kept posted up, and made thoroughly acquainted with English manufactures. A Vigilance Committee should be formed to see that the goods at different ports coming into this country are individually stamped with the name of the country from which they come, and not only the case they come in. This would put a stop to the present practice of some firms, who import job lots and rotten manufactured goods from abroad and export them again as British manufactured material, to the great damage of British manufacturers—"Veritas," please note. This is one explanation of the great increases in the import and export returns at a time when the country is passing through a record time of distress and want of employment. All British goods should be stamped with a trade mark which should be recognised and protected throughout the Empire, and a black list should be kept of those firms trading under British or British-sounding names with the object of deceiving the purchaser. If they want British trade, let them bring their factories into the country and employ British labour, and they will be welcomed, every one of them. The Institute should be for the education, improvement and general enlightenment, as well as the maintenance and protection of British manufacturers; it must not be forgotten that many manufacturers have risen from the ranks. Above all, it must be an active institute open to all English manufacturers and consulting engineers, and not an institute that will admit any boy from school with a bundle of references and influential friends, while it excludes more capable men and experienced engineers because they do not possess that influence. In conclusion, I ask for an influential man to come forward and establish an institute or union on the lines mentioned. Perhaps Mr. Byng will act if some others of influence will offer assistance; I can promise that they will not want for willing and active supporters.

Jaybee, not a Fooled Englishman.

The Wiring Industry.

I have of late read in the Electrical Review a lot concerning the wiring industry; a certain amount of truth is attached to it, and I quite agree with the suggestions of Mr. E. A. Hall. I myself think that an electrical wireman should be a good fitter, as he is called on very often to fix dynamos, motors, gas and oil engines, water turbines, &c.; in fact, a wireman should be capable of doing all in connection with a complete electrical plant. As I am a wireman and general electrical erector, I have done the above, so can speak from actual experience. I am not speaking for only a few years' experience, but for over 15 years' continuance in the above; any brother wireman that has been in the trade as long as I have, and a good many, perhaps, longer, knows this. I believe if there was some sort of an electrical protection society there would not be so much jerry wiring done, of which I have come across a great deal. Plumbers have got in large letters over their premises "authorised plumbers"; could not electrical engineers have it over their works and shops as authorised electrical engineers?

A great deal depends on electrical work as to loss of life and property, which we have read a lot about of late years, caused through inefficiency of workmen and bad material. There are a lot of so-called electrical engineers who take contracts on at a loss, knowing they are losing money, but if remonstrated with they simply say they are doing it for advertisement; this is a bad start in the electrical business, especially if they get men at a low rate, which makes it worse still. I heard not two years ago that a certain firm took a free library to wire not 10 miles from Manchester, of which the material and fittings cost more than the accepted contract, and labour was thrown in. How true this is I cannot say; but if true, it is ruining the electrical industry. Now, there is another thing—how these so-called electrical engineers start in business. One gets in favour of people who put faith in him, starts as a full-blown electrical contractor, and goes on in a big way for a time with plenty of orders, and gets his material on a month or three months' credit, and pays a bit off on the first sub., then gets, perhaps, six months' credit, and gets plenty of orders at a killing price. No one else can tender against him at so low a price, consequently he reaches the end of his journey as a bankrupt, and gets let off very leniently, and, perhaps, has another go—that is, if no one is looking. This is another ruination of the electric industry, and there are plenty more foul ways that are ruining the electrical trade.

Here is another thing we come in contact with, and that is fittings. I have come across fittings turned out by large electrical firms, that have been selected from their catalogues, and when delivered could not possibly be wired without the stems having to be drilled to admit of wire being drawn into them, and the burr in the different internal parts has been left to be cut and filed off by the wireman. Do not these firms have an electrical expert to pass them? I have known fittings take several hours to put right for fixing. The firms that manufacture these fittings cannot have the right man in the right place, and the men that design these fittings have but a poor idea of how they are to be fixed.

I remember some two years and nine months ago I went in answer to an advertisement I saw in a Manchester paper for a charge wireman, and I got the job in preference to about 30 Manchester wiremen. When I produced my references and testimonials, of which I had a good many, one of the firm, with a twist of his moustache, said that he did not take any notice of testimonials; had they done so previous to this they would not have been in the fix that they were, as the work that they had in hand had been completely bungled up. It took myself and another young fellow nearly nine months to make it passable.

I had occasion to go to a place called Hale, in Cheshire, to fit up some fittings in a private house, and I had on this occasion to cut out all the joints in the house that I could find, as they were only dry joints; not one was soldered, and a lot of them had been hot due to arcing. However the job was passed at first I could never make out. I remember also not long ago a fire originated in an insurance office in Manchester, caused through a double-pole ironclad switch, where a screw got loose in the mechanism of the switch and got fused to the cover, in which position I found it on testing.

I could write a whole book on these defects. However, in conclusion, I would warn intending users of electric light and machinery to consult a good electrical engineer of repute, who will see that everything is of the best material and the workmanship of the finest; although it might cost more at first, it will be lasting and safe, as I know that such installations are working now that I have fitted up 14 years ago. I think this is a very fair trial for an installation, and it might be 14 years more before it will want renewing.

The electrical trade will never be in a flourishing condition if some of our leading electrical engineers do not move in the matter and protect the electrical industry.

Se-Sen-Hor.

"Hygienic" Telephones.

We have repeatedly refused to grant the Sterling Telephone and Electrical Co. (formerly the Berliner Telephone Manufacturing Co.), the privilege of advertising themselves by drawing us into correspondence in the Press. However, with your permission we will grant them the favour this time.

Mr. Birnbaum states that for "weeks past" his firm have advertised and offered for sale their Hygienic telephone, and claims it to be the first hygienic instrument ever offered to the British public. He accuses us of "bluff" when we state that we have given our attention to hygienic telephones *for a long time past.*

Many of your readers will, no doubt, still have in their possession our catalogue, 1899 edition, on pages 1219 and 1204 of which we illustrate and offer for sale a G.E.C. Hygienic telephone which was made under licence of a patent belonging to the late Mr. W. E. Langdon, telegraph superintendent of the Midland Railway, and Past-President of the Institution of Electrical Engineers.

Mr. Birnbaum was probably not in the telephone business as early as 1899, which may account for his mistake in con-

sidering as "bluff" what, after all, proves to be his own lack of knowledge.

For **The General Electric Co., Ltd.**
P. P. Kipping,
Commercial Manager and Engineer,
Telephone, Telegraph and Signalling Department.

London, E.C.,
October 16th, 1905.

Booth's Circus.

In re Mr. Johnson's letter on this subject, it would be interesting to have further particulars of the alleged failure, such as the crossing where it was tried, the diameter of the circus, whether the ordinary traffic also was similarly treated, the method of points and turnouts, &c. Nobody will, of course, contend that the diameter of the circus is not a matter of importance. It seems to be that the dimension should be of the order $D = d \times x\,n$ where d is a fixed minimum diameter for any circus, x a coefficient, and n the percentage of time wasted, as determined by the experts of the Traffic Commission. Thus the diameter would increase with the traffic. I am having thrust upon me all manner of obstructions anent this circus idea, and have been compelled to the conclusion that 90 per cent. of our fellow men have no imagination, and hence are simply dull driven obstacles to progress of any sort. One gentleman says it will cost money to enlarge circuses, having already forgotten that the circus idea is primarily intended to save 30 millions sterling by spending three. Another brilliant intelligence assures me that I am a fool to accept the Traffic Commission's figures of 30 and 40 per cent. delay of traffic at the bad crossings. He says the men who had to do the timing were not capable of accuracy, and himself evolved from his obstructive, and I fear obstructed interior about 5 per cent. delay, thus, in fact, denying there was any delay at all.

As regards the principle involved, it is, of course, perfectly obvious to all but the above and his kind that no actual curvilinear *circus* is necessary. A circus within the meaning of the principle might be a rectangle of four streets surrounding a huge block of buildings. The principle of the circus would be secured by the rule that all traffic into and in those four streets should be clockwise, and, generally, where an actual circus should be enlarged it would appear reasonable to make it of large size so that a building might occupy the central area if too large to be wasted, as some might think, on a garden, though a central lake in which to lay up for the winter certain steamboats might approve itself. As so few appear willing or able to take a serious view of this suggested means of traffic easement, it might add dignity to the idea to surround the central area with statues of notable London County Councillors, to whose endeavours the present crushing burden of rates for which so little can be shown is due.

W. H. B.

Westminster,
October 17th, 1905.

An Overcrowded Profession.

It is my first duty to say that your correspondent, Mr. Browne, is quite correct in assuming that no discourtesy was meant in my last letter. The fact is, the promoters of the *University Engineering Journal*, of Birmingham, have endeavoured to chronicle all the developments and improvements in connection with the Applied Science Section of the Midland University, and for this reason, believing that they are doing good work for the cause of higher technical education, they are quite willing to send their publication to those interested in University education for engineers.

It is somewhat difficult to answer the question concerning a certificate in engineering at this University. The course is devised for four years. It includes the usual subjects for lectures and laboratory instruction taken for B.Sc. in Engineering in the London, Victoria or other Universities. In addition there are large workshops (fitting, turning and pattern making, a foundry and a smiths' shop) for practical instruction. Some months in each year are spent in practical work, because the usual University course is for three years.

There is to my knowledge only one college in England which has ever given a complete practical and theoretical training for five or six years, and that is the Admiralty College at Keyham, Devonport. This instruction is certainly far better than that of any college in America or Europe, but the course of instruction is only open to an occasional few outside those engineers entering the Royal Navy. The fact that most of our greatest marine engineers have passed through Keyham speaks for itself. Birmingham seems to be following almost identically on the Keyham lines.

I hope that when I can find time to do so the courteous editors of the Electrical Review will allow me to contribute some notes on both the Keyham and Birmingham systems of technical education, as I am sure that they will serve as a guide to those who have to formulate schemes of instruction for engineering students. In conclusion, I may assure your correspondent that it is my firm belief that four years at Birmingham will enable a competent student to obtain a good situation.

The Editor,
The University Engineering Journal.

Birmingham, *October 15th*, 1905.

Re-Winding a Motor.

I should like to know if any of the readers of the Electrical Review could give me any experience and results of having used a series-wound motor, and converting it into a shunt motor; with the only alteration of taking out the series spools and replacing with shunt-wound spools of same H.P. made by another firm.

S. R.

Jerry Wiring.

I enclose one of many similar joints cut out of a large mill installation during the past few days. These joints are insulated with one layer of adhesive tape, a No. 16 wire carrying 3 amperes, with joints as sample.

If you could publish a sketch or photo in your valuable paper, showing the joint as sent, it would, no doubt, interest your readers, and, at the same time, give an idea of the class of work being turned out by certain so-called electricians.

H. Moss.

Huddersfield, *October 16th*, 1905.

[The "joint" is one such as we have many times illustrated in the past, but, unfortunately, they do not lend themselves to satisfactory reproduction. This one simply consists of two little hooks on the ends of the wires (which have apparently been bared with a piece of hoop-iron); these are hooked together, dabbed with some sort of compound, and half-covered with a scrap of tape. Language fails adequately to condemn this kind of thing. It is on a par with the crime of carrying friction matches into a fiery pit. One can sympathise with the company that insured the mill, and congratulate it upon the providential escape of the mill from fire, but the architect or other person who was responsible for accepting and passing such work deserves to be pilloried. The stocks were a most salutary institution of olden time, and it is a pity they are no longer used.—Eds. E.R.]

Lead-Covered Wire.

In last week's Review we noticed a letter from Mr. Whipple with reference to wiring with lead-covered wire, which, he mentions, has been greatly favoured by Lancashire engineers.

It has always been somewhat of a mystery to us why this system of wiring, particularly with twin lead-covered wire, has not been used to a much greater extent than it has. For our own part, we have used it very largely for many years past, and invariably with great success. In fact, on only one occasion in some 15 years' experience have we had any trouble at all due to breakdown, and on that occasion it was due to rats having bitten through the lead covering

and the insulation. Even this occurred in a large provision warehouse, where rats might be expected to be plentiful and large.

From our experience, we think Mr. Whipple is wrong in stating that lead-covered wire is hygroscopic—at any rate, except as regards an inch or two at the end of a run of wire. Our experience has been that it is far more water-tight even than a screwed barrel system of wiring, as even then water almost invariably collects in the tubing, and eventually rots the insulation. We have had twin lead-covered wire installed in swimming baths, cold storage rooms and similar places for years without a penny having been spent on upkeep or repairs, and even in the vat room of a large brewery, where there is a continuous acid distillation on the walls. This, we think, is sufficient proof that lead-covered wire is not hygroscopic, and also that it is quite permanent as a protection for the insulation.

Of course, another important point is the first cost of an installation, but here twin lead-covered wire shows up very well. Generally speaking, the cost is not higher than for casing and capping, although, of course, this largely depends on the particular installation.

We should be glad to give you any further particulars as to our experience with this system of wiring, and, in conclusion, may mention that it has had the approval of every fire insurance company with whom we have come into contact, and also of the supply companies for pressures up to 240 volts.

Trusting this information may be of interest to Mr. Whipple—

Tyler & Freeman.

London, *October 17th*, 1905.

The Truth About Gas.

My letter to you of the 3rd inst. does not seem to have been relished by the *Journal of Gas Lighting*, judging by the way I am criticised. The above-named paper (still doing all it can to hamper the progress of electric lighting) no doubt imagines that gas, having superseded tallow candles and oil lamps, is to be the light of the future. This is a strange delusion, as it is a well-known fact that gas as an illuminant is on its last legs, and before very long will be extinct.

For outside lighting, incandescent gas is of no use whatever, as round each street lamp is a circle of sickly green light, which not only has a depressing effect on everyone, but is a dismal failure as far as the lighting of the street is concerned.

Those bigoted persons who abuse electric light simply because they have interests in gas companies are more to be pitied than blamed, as some men will swear black is white if it is to their advantage.

In a street lighted by electric arcs everything is shown up clearly, and people can be recognised a good distance away, there being no dark spaces between the lamps as in the case of incandescent gas. I should like to escort some "gassy" men round Bradford on a windy night, and show them the poor shivering mantles trying hard to give a steady glimmer, and failing miserably. It is quite worth a visit to Bradford, if only to see its gloomy streets, which being "lighted" by incandescent gas, are in a state of semi-darkness. Nine miles away is Leeds, its streets brilliantly lit by arc lamps. Here are two towns that are close together, and might well be taken as examples of light and darkness. I maintain that gas for street lighting is a failure, though it is very useful in cellars, alleys, &c.

An Old Reader.

The Design of Instruments and Meters.

We are pleased to note that "O. K." in his letter in your issue of October 13th, asks us two definite questions with regard to our "Inkless" Recorder. Had he done this in the first instance, much of your valuable space would have been saved. To these questions we will reply as briefly as we can.

As regards his first question, "I wonder if the makers imagine that switchboard makers and users wish to complicate unnecessarily the wiring of their switchboards?" the answer, needless to say, is "No." The question which we fancy "O. K." really wished to ask, but for some reason or other does not, is this: "I wonder if the makers admit that they are unnecessarily complicating an otherwise simple (though admittedly unsatisfactory) apparatus like the ordinary "inky recorder." To this question also we can reply emphatically, "No."

"O. K.'s" second question is as to whether we "Think that a pen using *fluid* ink, if decently designed (and such things do exist) is preferable to an 'inkless' pen, with all its attendant complications."

We have nothing to say against the design of recorder pens; in fact, we have used and are still using large numbers of them. They have a very difficult task to perform, and, all things considered, they are many of them really marvellous.

Would not "O. K." consider the "Hay motor," which labours along with the time-honoured penny 'bus, "decently designed?" And yet, strange as it may appear, there are many people who seem to prefer the petrol motor-'bus, in spite of all "its attendant complications."

We do not know whether "O. K." has taken advantage of our offer, and has inspected one of these recorders at the Olympia Exhibition. If not, we have much pleasure in renewing it, and would remind him that this is the last week of the Exhibition. We would also venture to suggest that on a future occasion he would save trouble were he to examine an apparatus before discussing its merits rather than afterwards.

Everett, Edgcumbe & Co., Ltd.
Kenelm Edgcumbe, *Director.*

Westminster, *October 17th*, 1905.

I cannot but admire the way in which "O. K." defends a "forlorn hope." Had he had some 8 or 9 *inky* recorders to look after for nearly two years, as I have done in the past, he would appreciate a praiseworthy and successful effort to do without ink and all *its* attendant complications, and would be loudly singing on the opposite side to that on which he is croaking at present.

His contention about the complication of wiring seems peculiarly foolish.

It would be about as sensible to say that one must not have more than one light for illuminating the switchboard, because of the complex nature of the wiring required for two or three!!

I could say a good deal more on this vexed question of "complications," but refrain.

Owl.

BUSINESS NOTES.

The Milan International Exhibition, 1906.—We have been requested by Mr. Arthur Serena, Hon. Executive Commissioner for Great Britain at the Milan Exhibition of 1906, to state that H.M. the King of Italy will offer prizes to the extent of £1,600 to exhibitors. This amount will be divided as follows:

1. A prize of £200 for automatic safety couplings for railway rolling stock.
2. A prize of £200 for the best method of testing high voltage electric currents without danger to the operator.
3. A prize of £400 for the best and most original exhibit of machinery or manufacturing process.
4. A prize of £200 for the best established method of distributing healthy and pure milk in centres of population.
5. A prize of £400 for the best type of popular dwelling adapted to the climate of northern Italy.
6. A prize of £200 for motor boats.

In addition to the foregoing, a national prize of £200 will be given to the public institution or private society which during the last ten years has been most successful in the work of reclaiming waste lands in mountainous districts, and in the improvement of pasturage.

These special inducements to exhibiting will doubtless possess attraction for British manufacturers, inventors and others, who should without loss of time address themselves for further particulars to the Hon. Executive Commissioner of the British Section, 1 and 2, Oxford Court, Cannon Street, London, E.C.

France.—The report of the Société Lilloise d'Eclairage Electrique, of Lille, for the last financial year shows a profit of 12,404, which admits of a dividend of 6 per cent.

Consular Notes.—Peru.—The German Consul in Arequipa reports that the electric lighting of the town is being carried out by German works, particularly Siemens & Halske. It is proposed also to equip electrical power works, and the construction of these also will probably be given to German firms.

Brazil.—The German Consul at Paramaribo reports that nothing further has been done regarding the proposed erection of electric lighting plant for that town. A proposal presented by the Governor has not been accepted.

Spain.—The German Consul at Bilbao states that electrical affairs in that town are chiefly in the hands of German firms. In the year 1904 the Allgemeine-Elektricitats Gesellschaft and the Siemens-Schuckert Works established branches in Bilbao. An agreement was shortly after entered into between the Allgemeine-Elektricitäts Gesellschaft and the American Thomson-Houston Co., whereby both companies were amalgamated under the title "The General Electrical Co. Thomson-Houston Iberica." The Hidro-Electrica Iberica, a company formed in 1901, with a capital of 20,000 pesetas, for the exploitation of water power in the provinces of Burgos and Guipuzcoa, was put into working order in 1904, and now supplies current for lighting and power purposes in Bilbao from a distance of 30 to 40 kilometres. The plant was erected by the Siemens-Schuckert Works.

An Exhibition at Bristol.—At the Drill Hall in Queen's Road, a Trades and Industrial Exhibition was opened on the 2nd inst., and is to close to-morrow. As representing the electrical industry, Messrs. Helps, Woodfin & Co., of Old King Street, had a very attractive exhibit, which comprised dynamos and motors, art fittings, telephones, electro-medical and scientific apparatus, &c. Many of the electrical accessories on view were made at the firm's own works, and they are now open to supply machines for D.C. as well as for alternating supply.

Deed of Assignment.—James Moores (trading as Moores, Farrell & Co.).—A meeting of creditors in this matter was held at Manchester on 11th inst., when a statement of affairs prepared by Messrs. Whittaker & Provis, chartered accountants, was submitted, showing liabilities expected to rank for dividend amounting to £3,215 15s. 8d., and assets estimated to realise £1,526 16s. 5d., after deducting the preferential claims for rent, rates, &c. Mr. Moores' offer to execute a deed of assignment of all his estate to Mr. C. W. Provis, chartered accountant, 3, Mount Street, Manchester, upon trust to realise the same, and distribute the proceeds amongst the creditors, with a committee of inspection of three of the larger creditors, was accepted by unanimous resolution of the creditors present representing debts amounting to £2,680.

New Feeder Pillar.—Although not exhibiting at Olympia, the British Insulated and Helsby Cables, Ltd., material was in evidence in the form of their new Downe's patent feeder pillars, of which six are installed, four being in use for the supply of the Exhibition. These pillars are circular in plan, and are built up round a central column; the outer iron case is free to revolve when a catch is lifted, and the door, which is only 9 in. wide, can thus be brought opposite any one of the eight sections or "panels" contained within. Each of these panels consists, in effect, of the end of a cable, and obviously only one panel is exposed at a time. Provision is made for supporting the cables and attaching the switch-fuses and bus-bars to them, and a special feature consists in the fact that the whole of the work on each cable can be done on the ground outside the pillar; when all is ready, the cable end is simply turned up into the pillar, clamped in position, and the bus-bars joined up with links. If a fault occurs in a pillar, any cable can be pulled out alone, dealt with and replaced, without making the whole pillar dead, and in perfect safety. Moreover, the pillar can be made rectangular, when it has no "back," and can, therefore, be built up against a wall without inconvenience.

The design is highly original, as will be gathered from this brief statement, and the whole thing is remarkably compact, occupying no more space than an ordinary round letter-box. The idea is due to Mr. R. S. Downe, of Southport electricity works, and, we understand, has already found favour with supply engineers.

Imports of Foreign Electrical Apparatus.—It is worthy of note that while a shrinkage is taking place in the importation of foreign electric machinery into this country, an upward tendency is apparent in the imports of electrical goods and apparatus. The returns relating to the latter for September last show a total of £67,028, which contrasts with £63,699 in the corresponding month of 1904. For the nine months ending with September the aggregate imports have amounted to £681,841 as compared with £565,964 in the first nine months of last year.

The Telegraph Cable Export Trade.—Following on a very active month September proved exceedingly quiet as regards the exportation of telegraph cables and apparatus connected therewith, the shipments attaining a value of only £49,603, as compared with £440,329 in August last. For the year to date, however, the trade is well in advance of 1904, the aggregate exports for the nine months ending with September being returned at £1,158,945 as contrasted with £627,522 in the corresponding period of last year.

Rubber Imports.—According to the Liverpool Chamber of Commerce *Journal*, the rubber imports into the United Kingdom for 1904 equalled £7,700,000. The following figures are given:—Brazil, £4,553,500; French West Africa, £626,000; Peru, £500,000; Gold Coast, £328,500; Niger Protectorate, £216,300; Straits Settlements, £214,000; U.S.A., £110,400.

Brush Contracts.—The following orders have been booked by the Brush Electrical Engineering Co.:—

Mansfield Light Railway (per J. G. White & Co.) one watering and rail-cleaning car.

Victoria Jubilee Technical Institute, Bombay, 80-kw. dynamo for educationa general purposes.

W. Baird & Co., electric coal-cutter.

For Sale.—Messrs. Percy Huddleston & Co. will, on November 1st, offer for sale by auction the patents, designs and stock-in-trade of the British Prism Globe Electrical Co. (in liquidation), at Sheffield. The Postmaster-General is inviting offers for the sale of old Post Office stores. Further details appear among our advertisements to-day.

Trade Announcements.—Messrs. Clarke, Chapman and Co., Ltd., have decided to open an office at 21, Mountstuart Square, Cardiff, to deal with the whole of the South Wales district. This decision has been arrived at on account of the extension of their electrical business in that district, and also on account of the success of their "Woodeson" water-tube boiler and "Woodeson" pumps on the North-East and West Coasts. Mr. George Winn, who has been at the company's Gateshead Works for some 12 years, will take charge of the Cardiff office on and from November 1st.

We hear that Mr. A. E. Blower, who has been connected with the electrical trade for the last 15 years, is now representing the London Electrical Fittings Co., Ltd., of Roberts Works, Hampstead Road. This firm is doing a big business in high-class electric light fittings; it also has some good specialities in accessories, and is the London depôt for the Wandsworth Electrical Manufacturing Co., of Birmingham, whose switches and other material it is handling.

The Wandsworth Electrical Manufacturing Co., Ltd., 9 St. Paul's Square, Birmingham, the makers of the "Wandsworth" switches, wall plugs and other accessories, have appointed Mr. J. E. Gledson, 25, Eldon Square, Newcastle-upon-Tyne, to represent them in the Newcastle district. The Power Appliances Co., 22, Renfield Street, Glasgow, are their representatives for Scotland. The London address of the firm is Roberts Works, Hampstead Road, N.W.

Messrs. W. F. Dennis & Co., of Albert Buildings, 49, Queen Victoria Street, E.C., have been appointed sole agents for Great Britain and the Colonies by Les Ateliers du Roeulx, Le Roeulx, Belgium, who are manufacturers of railway material, including fixed and rolling stock, tenders, goods trucks, &c., tanks of large capacity, oil cups and grease boxes, turntables and switches, bridges, poles and iron construction, points, crossings and signals, hydraulic and gas apparatus, and castings of all kinds.

The Union Electric Co., Ltd., announce that the address of their office in Glasgow has been transferred to 12, Waterloo Street, Glasgow, where it is in charge of Mr. Alexander Morrison, who is the company's representative for Scotland. Mr. Morrison has had considerable experience in the heavier lines of electrical engineering, having served his time with Messrs. Mavor & Coulson, and subsequently been in the employment of Messrs. Haddow & Co., contractors, of Glasgow, and finally engaged in the tramways department of the Glasgow Corporation.

The registered offices of the Primitiva Gas and Electric Lighting Co. of Buenos Ayres, Ltd., are now at 153, Leadenhall Street, E.C.

The Direct Spanish Telegraph Co., Ltd., have just opened an office in Cardiff at 33, Merchants' Exchange (Bute Docks), which is in direct communication with their cable system between England and Spain, *vid* Bilbao.

The Stirling Boiler Co., Ltd., have removed their Glasgow office to their head office at Motherwell.

The Kingsway Ceremony.—The apparatus controlling the gates of Kingsway was furnished by Messrs. Electromotors, Ltd., of Openshaw, Manchester, to the instructions of the Chief Engineer of the London County Council. The gates were attached by means of ropes to electric winches, one on each side of the roadway. These winches consisted of 2½ B.H.P. motors, direct coupled to worm gears provided with drums for hauling in the ropes. The gold key, inserted by His Majesty into the pedestal on the dais, closed an electric circuit, which in turn, brought the automatic solenoid self-starting switches into circuit, thus starting the motors and gradually opening the gates. When the gates were fully opened, they automatically disconnected the circuit by means of trip switches, thus bringing the winches to rest. The solenoid self-starting switches were of the Sturtevant Co.'s make.

Visit of Employés to Olympia.—A trip was arranged for the employés of Messrs. Ferranti, Ltd., to visit Olympia Electrical Exhibition on Saturday, October 14th. A party of 170 men assembled, leaving Manchester at midnight on Friday by the Great Central Railway. Messrs. Ferranti, Ltd., contributed towards the general expenses of the trip, provided breakfast on arrival in London, and a luncheon in the restaurant of the Exhibition, at which the directors of the company were present. Each man was furthermore supplied with a pass to the Exhibition. Some of the party returned on Saturday evening, while others deferred their departure until the following day. The trip was eminently successful, and will, it is hoped, prove to be of educational advantage to the employés of the firm.

Bankruptcy Proceedings.—Thomas Hill, electrical engineer, 24, Vicarage Road, Wolverhampton.—Receiving order made October 9th, on debtor's own petition.

Walter Binns.—In the matter of Walter Binns, of Stanhope House, Frizinghall, carrying on business at 25, Cheapside, Bradford,

Yorkshire, as a contractor, a meeting of creditors (the *Yorkshire Post* says) has recently been held. At that meeting, although a trustee was appointed to take charge of the estate, the statement of affairs was not ready; but since then creditors have received such a statement from the Official Receiver, Mr. C. L. Atkinson. This puts the liabilities expected to rank at £13,658 6s. 4d., and the assets are estimated to produce a similar amount. The petition in bankruptcy against the debtor was filed by a creditor, and the debtor does not admit insolvency. The debtor's explanation of his position is that he has been a railway contractor for the last 25 years, and has always had an office in Bradford. In 1902 he projected the Mexborough and Swinton Tramways and the Saddleworth and Springhead Tramways, in Lancashire, and applied to Parliament for the necessary powers, which he ultimately obtained. He then (he states) entered into an agreement with the New General Traction Co., Ltd., who agreed to take over his rights and powers in connection with the Mexborough and Swinton scheme at the price of £20,000, to be paid £10,000 in cash and the remainder in fully paid shares in the company to be promoted by them for the purpose of constructing and working the Mexborough and Swinton Tramways. The promotion of that company, the debtor further says, fell through, and the business in connection with it was suspended last year. Then the debtor entered into negotiation with other people with the object of inducing them to carry out the scheme. He states that, about a year ago, he approached Mr. Godfrey C. Isaacs on the subject, and an arrangement was made that Mr. Isaacs should form a company or syndicate to construct and work the Mexborough and Swinton Tramways, paying the debtor for his rights £15,000 in cash and £10,000 in shares in the company, when formed. The debtor says he executed a power of attorney to Mr. Isaacs to act for him and to discharge his liabilities in connection with the promotion of the Mexborough and Swinton Act of Parliament and any other costs and expenses he had incurred in connection with it, and any balance remaining of the purchase price. The tramways are now in course of construction by the National Electric Construction Co., acting under the instructions of Mr. Isaacs. The debtor says he has not received any portion of the cash and shares, nor received any statement of liabilities which Mr. Isaacs has paid on his behalf, and that he is unable at present to pursue the matter further in consequence of Mr. Isaacs' temporary absence abroad. With reference to the Saddleworth and Springhead Tramways Act, in which the debtor had a half share, the construction of the tramways has not yet been begun; in fact, the scheme has not advanced beyond the stage of obtaining the necessary Parliamentary powers, though, it is stated, he has sold his share in the concern to his partner for £2,000.

Dissolutions and Liquidations.—Messrs. Newman Wilkinson & Horace F. Simon, of 43, Mincing Lane, E.C., have dissolved partnership, Mr. Newman Wilkinson retiring. Mr. Horace F. Simon will carry on the business of general electrical engineers as heretofore, under the style of Horace Simon & Co., at the same address. He will attend to all debts of the old firm.

Electrical Supplies, Rubber & Ebonite Co., Ltd.—A meeting is to be held at Oxford Court, Cannon Street, E.C., on November 20th to hear an account of the winding up from the liquidator, Mr. C. F. Elles.

P. J. Driscoll & Co., electrical engineers, Portland Street, Wardour Street, London.—Messrs. P. J. Driscoll and C. Balbiani have dissolved partnership.

Crypto Works Co., Ltd.—A meeting is to be held on November 14th at 79, Mark Lane, E.C., to hear an account of the winding up from the liquidator, Mr. Elles Hill.

Electric Light Insurance and Maintenance Co., Ltd.—Meeting to be held November 14th at 79, Mark Lane, E.C., to hear an account of the winding up from the liquidator, Mr. Elles Hill.

F. Parkin & Co., india-rubber, asbestos and engine-packing manufacturers, Moorside, Cleckheaton.—Messrs. F. Parkin and W. H. B. Flather have dissolved partnership. Mr. Flather will continue the business under the old name and will attend to debts.

W. F. Mason, Ltd.—In the Vacation Court on 11th inst., the petition of Mason's Gas Power Co., Ltd., for the winding-up of this company, was ordered to stand over for a week to permit of an arrangement being carried out for the payment of the creditors.

Catalogues and Lists.—Messrs. Siemens Bros. and Co., Ltd., Westminster, S.W.—A very useful blue binder, strong and of attractive appearance, has been received from this firm for filing their various blue pamphlets and circulars as issued. Two recently published pamphlets, upon whose excellent get-up and arrangement the firm's publicity department is to be congratulated, have also been received; one gives a finely-illustrated account of the Siemens works at Stafford, with many recently taken photographs; the other gives descriptive particulars and pictures of direct coupled continuous current Siemens generators for lighting, power and traction. A third publication, being an illustrated price list of Lilliput arc lamps, has also been issued; it has red covers, and when further lists are issued a red binder to hold these will be distributed.

Messrs. W. T. Glover & Co., Ltd., of Trafford Park.—A new joint box list, and also a handy little booklet of 95 pp., containing electrical mining rules and data. These have been compiled with a special view to portability, and the giving of a maximum of information in the minimum of space. The mining data booklet is very timely because this branch of electrical work is undoubtedly becoming of greatly increased importance, and it certainly contains a great deal of valuable matter. The joint box list is a four-fold card giving illustrations and prices of a number of Glover's single, concentric and multicore joint boxes. The company will send a copy of either publication to anyone interested.

Edison & Swan United Electric Light Co., Ltd., London, E.C.—A very fine and complete catalogue showing with excellent illustrations a variety of artistic electric light fittings. This is Section VI. of the company's publications, and it will be needed during this season by many engineers, architects and contractors. We may refer to it later next week.

Forest City Electric Co., 3, Gore Street, Piccadilly, Manchester.—A small 8 pp. pamphlet giving "A few plain facts about rail bonds"; the "Forest City" protected bond, its manufacture, method of fixing, and its advantages, are described, and a list is given of tramway systems in the United Kingdom on which such bonds are used.

The Simplex Steel Conduit Co., Ltd., Birmingham.—Leaflet describing their watertight station junction and bracket boxes, a large number of which are used in the wiring of the Metropolitan and District Railway Stations. Large quantities are also being supplied for colliery service. Copies of this leaflet will be sent on application to the company.

Messrs. James Lumb & Sons, Evulcan Street Works, Elland.—Circular relating to Siemens'-Martin "Evulcan" steel castings. The company's cast-steel wheels have been employed on the Halifax tramway system with very satisfactory results.

The General Electric Co., Ltd., are circulating a handy whistmarker as a novel form of keeping their "Robertson" Wytelite Lamps before engineers and the public.

LIGHTING AND POWER NOTES.

Aston.—On October 5th a L.G.B. inquiry was held relative to the application of the T.C. for a loan of £50,000 for the E.L. undertaking. It was explained that the loan obtained in 1902 had been exceeded by £20,000, the main items of excess being £8,515 in respect of cables, and £5,362 spent on motors and free wiring. With regard to the balance of £30,000, that was for the extension of the power station and plant. There was no opposition.

Australia.—Sydney.—At the last half-yearly meeting of the Empire Electric Light Co., the chairman, Mr. Robert Imray, in moving the adoption of the report and balance-sheet, stated that during the half-year under review, 22 per cent. more energy was sold than in the similar period of last year. A dividend at the rate of 6 per cent. per annum was declared, £1,000 placed to the reserve fund, and the balance carried forward.

Barnes.—The U.D.C. has decided to allow consumers of energy for power and heating the following discounts off their accounts:—6,000 units and under 8,000, 20 per cent.; 8,000 units and over, 25 per cent., when those amounts are reached monthly.

Brandon.—The U.D.C. has received from the County of Durham Electric Power Distribution Co. a request for consent to their application to the B. of T. for a prov. order; it was pointed out by the company that unless consent was given at once it would be too late, but the Council has decided to await a full report from a committee. The company has offered to supply energy when available for public lighting at 37s. per lamp per annum.

Brixham.—The B. of T. will not allow Messrs. Edmundson's Electricity Corporation to run H.T. cables along the road from Kingswear, and in consequence the Corporation is unable to carry out its scheme for lighting the public lamps with electricity, the tender of £500 for which was accepted in September last. At the time of inquiries the Brixham Gas Co. offered to provide 200 Kern burners and undertake the public lighting for ten months' lighting over five years at an annual sum of £400, a difference of £160 per annum on their original tender. It has now been resolved to accept this latter tender, and also to support the application of the Gas Co. for powers to lay down plant and undertake the supply of electricity for lighting and motive power in Brixham, subject to certain agreements.

Buckingham.—The local E.L. company has reduced the price of energy from 8d. per unit to 7d., with a rebate of 5 per cent.

Burslem.—The T.C. has fixed the following prices for energy for power:—Up to 500 units per quarter, 2d. per unit; 500 to 1,000, 1¾d.; 1,000 to 5,000, 1½d.; 5,000 to 10,000, 1¼d.; 10,000 to 25,000, 1d.; 25,000 to 50,000, ¾d.; above 50,000, ½d.

Carnarvonshire.—The hauling by road of some of the machinery to the works of the North Wales Power and Traction Co. has resulted in considerable damage being done to drains and culverts. The C.C. surveyor has presented a report to the Council, in which he states that a claim for expenses incurred during the six months ended July 8th last amounting to £1,269 has been sent in. The claim has not been satisfied yet, but the company has promised to pay. Nearly all the drains and culverts over which the heavy traffic passed were broken or damaged. Some of the castings hauled weighed about 14 tons, apart from the weight of the traction engine and wagons. The Council has accepted plans showing the route of the transmission lines from the power house to Quellyn Lake, and the branch line to the Dinorwic Quarries, also showing the transmission line from the power house to the Oakeley Quarries, plans of road crossings, and designs for showing a safety device for crossing roads.

Castleford.—The B. of T. recently asked the U.D.C. whether it proposed to carry out an E.L. scheme under the prov. order, and whether any company or person had intimated that they proposed to apply for an E.L. order. The Council on October 11th decided to reply that it was its intention to find the capital for a scheme, and to lease the undertaking.

Chester-le-Street.—The County of Durham Electrical Power Distribution Co. has again asked the R.D.C. to consent to the County of Durham Electric Power Supply Co.'s application to the B. of T. for permission to use overhead mains, it being pointed out that the two companies are in reality one financial interest, but have separate statutory powers. If consent were granted, energy would be supplied by the company at 3¾d. per unit, less 5 per cent. A member has given notice to move that the application be acceded to.

Continental Notes.—ITALY.—Application has been made to the Cosenza prefectural authorities to install a hydro-electric plant on the River Ampolino at San Giovanni, for the operating of an electric tramway between Cosenza and Cotrone, and for lighting purposes at Silani.

FRANCE.—An electric power station is being erected at St. Denis, and the machinery to be installed consists of four 5,000-KW. turbo-alternators, to generate three-phase current at 25 cycles, 5,000 volts. A 300-KW. D.C. set is also to be put down for excitation purposes.

An electric power station is to be constructed at Brest.

GERMANY.—We learn that Messrs. Brown, Boveri & Co. have recently constructed for the Rhenish-Westphalian power station a steam turbo-generating set, which is direct-coupled to a 5,000-KW. alternator and a D.C. machine of 1,500 KW. The set is designed for a speed of 1,000 r.p.m.

From the *Elektrotechnische Zeitschrift* we note that on April 1st, 1904, there were 1,028 central power stations in operation in Germany, seven times as many as there were 10 years ago, and 89 more than for the previous year. The 1,028 plants are divided over 993 localities; 313 belong to the municipalities, nine to the State, and 690 to private individuals or companies. There are 14 of which the ownership is not indicated. Eighty-two per cent. of the plants supply continuous current.

Dumfries.—Fully £3,000 worth of electrical machinery and buildings were destroyed by fire at Dalskairth Mansion House, near Dumfries. All the electric plant was ruined, and Mr. Campbell, the engineer, received serious burns. The fire was caused by some oil on the engine becoming ignited.

Dunfermline.—The Fife Electric Power Co. is negotiating with the T.C. in regard to supplying electricity; and the National Gas Engine Co., of Manchester, has offered to put down suction gas plant, generate electricity, and pay interest, depreciation and sinking fund, at ½d. per unit, or considerably below the terms of the Fife Co.

Edinburgh.—A recommendation has been made by the E.L. Committee that condensing plant be provided at Dewar Place station, at a probable cost of £13,000, and at M'Donald Road station, at a probable cost of £28,500; that authority be granted to make arrangements with the N.B.R. Co. to take water from the Union Canal for condensing at Dewar Place station; and that provision be made in the Bill which is to be promoted in Parliament, for powers to take water from the Water of Leith, for the M'Donald Road station. It was stated that it was proposed to lay a 30-in. pipe from Port Hamilton, and draw the water from the Canal to Dewar Place, whence it would be returned to the Canal by pipes leading to Port Hopetoun. Against the capital charge involved—about £845 per annum—there would be a saving on the coal bill and the water bill, and an increased output. In all £2,360 would be saved, as against the £845 of outlay. The N.B.R. Co. would require a certain sum per annum—£130 had been indicated—for the use of the water. As regarded M'Donald Road, there would not be the same immediate economy, and against this scheme there would be a saving in coal and other things, amounting to £1,955. The T.C. would require to go to Parliament to get powers, and it will be necessary to obtain increased borrowing powers or meet the cost out of revenue. It has been agreed that a report on the subject be printed and circulated.

Falmouth.—Electric light cables are now being laid throughout the town.

Blaenau Festiniog.—The T.C. on Friday decided to engage Mr. Yate, manager of the local E.L. Co., to maintain and light the public lamps for £50 for the season, in lieu of appointing a lighting superintendent.

Gellygaer.—The U.D.C. on October 12th considered the E.L. question, and it was decided to apply for a prov. order.

Gomersal.—The U.D.C. has decided not to oppose the application of the Electrical Distribution of Yorkshire, Ltd., for powers to supply electricity in the Council's area.

Gravesend.—In view of the plant at the Corporation electricity works being fully loaded, the engineer and surveyor have been directed by the T.C. to submit reports for a scheme of extensions.

The T.C. has instructed the electrical engineer to report on the proposed adoption of a free-wiring scheme.

Grimsby.—The T.C. has resolved to expend £9,500 on extensions to the electricity works, and also £8,500 on mains required to supply the G.C. Railway Co. with energy for lighting and power.

Hindley.—The Electricity Sub-Committee has recommended the U.D.C. to make arrangements with the Lancashire Electric Power Co. for the working of the E.L. order.

Horsforth.—The U.D.C. has decided to negotiate with the Yorkshire Electric Power Co., with a view to ascertaining whether the company would be prepared to undertake to put into operation the E.L. Order obtained by the Council, and upon what terms.

Huddersfield.—Parliamentary powers are to be sought by the T.C. for the wiring of houses for lighting purposes and the supply of energy to authorities outside the borough.

Hulton Colliery.—Referring to our recent note to the effect that an electrical installation had been put down at the Hulton Colliery Co.'s new Pretoria Pits, Mr. W. Bolton Shaw, electrical engineer to the colliery, informs us that the electrical installation at these pits (officially known as the Nos. 3 and 4 Atherton Pits) was put down some three years ago. Considerable extensions are now being carried out, including the transmission of about 300 KW. by overhead wires at 3,300 volts to other pits on the colliery.

Ince.—Wigan T.C. has asked the U.D.C. whether it will entertain the idea of transferring the E.L. order to the Corporation, and a sub-committee has been deputed to ascertain the terms upon which Wigan would be prepared to take over the order. The B. of T. has intimated that it is not likely that any further extension of time will be granted.

India.—MUSSOORIE.—From *Indian Engineering* we learn that the Municipal Board has applied for a loan of Rs. 7,30,000 from the Government for the Mussoorie hydro-electric water supply and lighting scheme.

Llangollen.—The U.D.C. has again deferred its decision regarding the adoption of an E.L. scheme, for further investigations to be made. The Lighting Committee had visited Liverpool and Hoylake and inspected the street lighting there, and reported that "with gas at the price," incandescent gas was cheaper than electricity.

London.—HAMPSTEAD.—The B.C. has resolved to alter its charges for energy for private lighting from 6d. per unit, one hour maximum demand, per half-year, and 2½d. after, to: Maximum demand system, during two winter quarters, 6d. for two hours and 1½d. after, and for the two summer quarters a uniform rate of 1½d. per unit; flat rate system, 4d. per unit.

BERMONDSEY.—The B.C. has resolved to apply to the L.C.C. for sanction to a loan of £5,390 for the following extensions to the plant at the electricity works:—500-KW. steam dynamo, £2,950; switchboard extensions, £325; boiler, £1,800; piping, £215; contingencies, £100; total, £5,390.

BATTERSEA.—A breakdown occurred at the B.C. electricity works on Saturday last at 9.15 p.m. This, we are informed, was caused by the armature of a 750-KW. turbo-generator failing at a time when it was supplying three-quarters of the total output. The supply was resumed at times varying from 10 to 45 minutes to various sections of the network.

FULHAM.—The auditor of the electricity accounts has pointed out to the Joint Finance and Electricity Committee that there is no authority in law for the combination of the electricity and destructor undertakings as a single enterprise. He further states that the electricity revenue is charged with the cost of maintaining the dust destructor, and the general rate is charged, and the electricity revenue credited with the value of the work of destroying refuse. Another point raised is the cost of providing the electric lamps and pillars for public lighting, which has been treated in the accounts as a charge upon electricity revenue; the cost of providing the lamps should be transferred to the general fund. The charge for arc lamps is at present £25, out of which all capital charges, maintenance, &c., are provided. The Committee has agreed to revise its system of book-keeping to meet the auditor's views.

From Mr. A. J. Fuller, the borough electrical engineer, we have received a well illustrated and nicely printed pamphlet, giving particulars and general information on electricity for lighting, heating, cooking, ventilating, and motive power purposes. It has been prepared for circulation among intending consumers in the borough.

Louth.—With reference to the refusal of the L.G.B. to grant a loan of £17,000 for the establishment of an electricity undertaking, the T.C. has resolved to ascertain whether the time for carrying out the prov. order will be extended. If so, leave to transfer it to a private company will be sought.

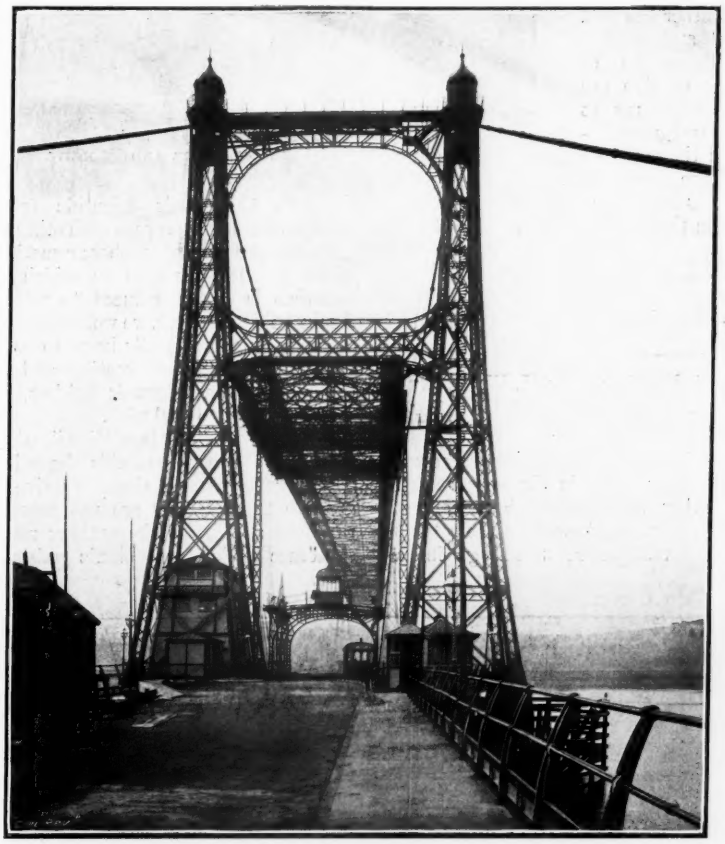
Mexico.—Application has been made to the Mexican Government by the Compagnie Miniere de Guadalupe de Los Reyes to put down a water-power plant on the River Piaxpla, in the San Ignacio district. The electrical energy generated is to be utilised in the ore-smelting works of the company.

(*Continued on page* 639.)

WIDNES-RUNCORN ELECTRIC TRANSPORTER BRIDGE.

Some time ago we recorded the formal opening of the electric transporter bridge which has been constructed over the River Mersey, between Widnes and Runcorn. This type of bridge has attained considerable prominence of late, several having been constructed abroad, while in addition to the Widnes bridge there is one under construction at Newport; a few particulars of the arrangement, therefore, especially as regards the electrical system, may be of interest to our readers.

The bridge itself is a handsome structure of the stiffened suspension type, with two main girders at a height of 82 ft. above high-water level. The span of the bridge is 1,000 ft. A trolley runs along the girders, from which a travelling platform is suspended by steel wire ropes, the platform or car being at such a height that when it is brought to rest at the terminals vehicles and passengers can pass on to it directly. The platform is capable of accommodating 300 foot passengers, at the same time as four two-horsed wagons, and the trip across occupies 2¼ minutes.



End View of Bridge and Car, showing Power House.

The trolley is carried on 32 wheels, of which 16 run on each rail, and is driven by motors mounted in the centre of the trolley, which receive power from a generating station on the bank.

The bridge was constructed by the Arrol Bridge and Roof Co., of Glasgow, to the designs of Messrs. J. J. Webster, of London, and J. T. Wood, Liverpool. The accompanying illustrations show the bridge and the transporter car.

The contract for the supply and erection of the electrical plant was placed by the Widnes and Runcorn Bridge Co. with Messrs. Mather & Platt, Ltd., of Salford Ironworks, Manchester, who have made a special study of the electrical working of bridges, two swing bridges over the River Weaver (described in our issue of February 1st, 1901), as well as the rolling bascule bridge at Barking, having been equipped with electrical plant by them; and the experience thereby gained has enabled them to introduce improvements on the methods previously used in the case of transporter bridges.

The power house is erected within the left-hand tower, on the Widnes side of the river, and contains the whole of the generating plant, which is driven by two gas engines made by Messrs. Crossley Bros., Ltd., each capable of developing 75 B.H.P. The cylinders are 16 in. in diameter, with a stroke of 21 in., and run at a speed of 210 r.p.m.; the gas is supplied from the Widnes town gas mains. The engines are fitted with the usual silencers and water-cooling pipes, the water supply being obtained from a large tank fixed at the top of the engine house. Either of these engines is capable of providing the whole of the power necessary to work the bridge, the other set being held in reserve.

To each engine is directly coupled a Mather & Platt multipolar dynamo of 48 KW. capacity, capable of giving a continuous output of 90 amperes at a pressure of 525 volts when running at 210 r.p.m. The engine room also contains a booster consisting of motor and generator directly coupled: this is used for boosting the pressure when charging the accumulators, and also for maintaining the voltage on the line, and equalising the load on the generating dynamos. The accumulator referred to is shown in our view on p. 638: it is placed in a room above the engine room, and consists of 245 cells supplied by the Chloride Electric Storage Co., having a capacity of 90 amperes for one hour. The cells are mounted on insulators carried on suitable stands. In the corner of the engine room is the main switchboard, arranged with three panels: one for the dynamos, with the necessary main and regulating switches and measuring instruments; the second for the accumulator cells and booster, similarly fitted up; and the third panel for the feeding and lighting circuits.

From the switchboard the two main supply cables are led up by the tower, and across to the main girders of the bridge, where they are attached to two overhead T-shaped conductors, which are carried by insulators below the cross girders of the bridge: from these the current is collected by trolley arms, whence it passes down to the controlling apparatus in the driver's cabin, which is placed on the top of the transporter car. The regulating apparatus consists of a circular type controller, by means of which the starting, regulating and stopping of the motors on the travelling

trolleys are effected. From the controller cabin the wires are led straight up to the motors, which are fixed on cross girders connecting the pairs of trolleys, which run on the continuous main girders of the bridge. The motors are of Messrs. Mather & Platt's steel-clad entirely-enclosed type, as shown herewith, and are capable of developing 35 B.H.P. each, when supplied with current at a pressure of 500 volts; they drive by means of gearing and shafts the driving wheels of the trolleys, and are arranged also to act as brakes for stopping the car. As shown in our views, the motors are entirely exposed to the weather. The control cabin also contains a small switch-board with the requisite switches and instruments for the information of the driver.

In addition to supplying the plant for the power, Messrs. Mather & Platt, Ltd., have also supplied and erected the electric lighting installation of the bridge; this consists of five arc lamps in each of the four lanterns at the summits of the towers, and incandescent lamps in standards on the approach roads on either side of the river, as well as the necessary lights on the car itself, and in the waiting rooms and offices on the landing stages.

View of Motor and Trolley.

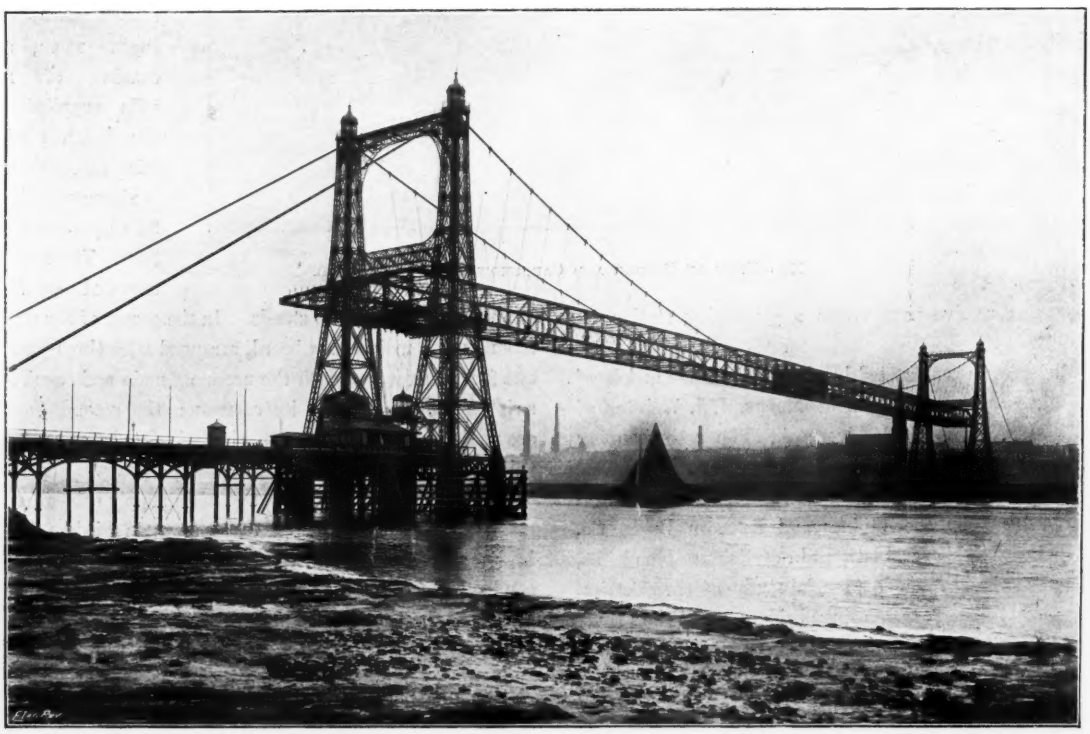
REVIEWS.

The Insulation of Electrical Machines. By H. W. Turner and H. M. Hobart. London: Whittaker & Co. 1905. Price 10s. 6d. net.

This work deals with a subject which has hitherto received less consideration than any other point in the construction of dynamo machinery. Other materials, such as magnet steel, armature stampings, copper, &c., have been the subject of progressive scientific investigation, resulting in a continuous improvement in their quality, whereas insulating materials have been largely neglected, owing, probably, to the fact that their scientific treatment offers greater difficulties than is the case with other substances.

In the preface, the authors remark that the insulation of cables is the only case in which the use of insulation materials has been reduced to some degree of exactness. Against this, however, we would point out that the insulation of cables does not usually have to withstand the mechanical stresses and frequent heating and cooling to which the insulation of machines is subject, and is consequently a simpler matter to deal with.

In defining the "insulation" of a given material, the authors point out that this depends on two qualities, the ohmic resistance and the disruptive strength. The values of these two qualities are not necessarily high in the same substance; in fact, the authors mention that generally a substance having high ohmic resistance will have a lower



Widnes-Runcorn Electric Transporter Bridge.

disruptive strength than one the ohmic resistance of which is lower. A high disruptive strength appears to be of more importance than high ohmic resistance, and consequently a high voltage test is better than a measurement in megohms of the insulation resistance of a machine.

Interior of Car, and Driver's Cabin.

The authors describe and illustrate various apparatus for testing insulation, and give a number of curves, taken experimentally, showing the electrical characteristics of various insulating substances.

In a chapter on the properties of insulating materials, some curves of a most interesting nature are given, showing the energy losses in insulating materials under different conditions, as well as the energy losses in the armature insulation of two Westinghouse 5,000-kw. alternators.

In a chapter on silk and cotton-covered wires, a curve is given showing the percentages by which the average commercial double cotton covering increases the weight of copper wire.

This is a useful curve for estimating the weight of d.c.c. wire for ordering, as in the case of the smaller sizes of wire the weight of the covering forms an appreciable proportion of the total weight.

Some curves are also given showing prices of insulated wire in "shillings per kilogram," a curious mixture of units. A number of chapters are devoted to descriptions and tests of various insulating materials, such as mica, micanite, ambroin, impregnated papers and cloths, &c., all of which contain useful information for the dynamo designer.

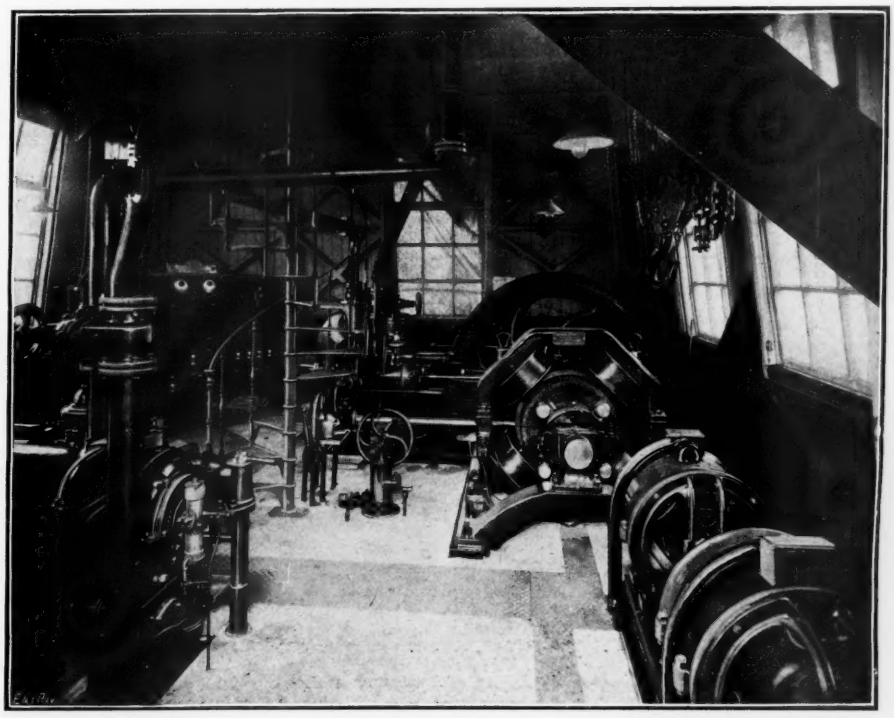
The recommendations of the Standardisation Committee of the American Institute of Electrical Engineers for specifications relating to insulation tests of machines are given, and appear to us to be the best we have yet seen. In particular, their remark that one megohm is sufficient insulation resistance for any machine should be noted by those engineers who are in the habit of specifying such insulation resistances as 25 megohms or more.

A valuable feature of the book is that it brings together the results of the investigations of all the principal workers, while it discloses to us the extremely backward condition of knowledge on the subject, and shows the necessity for extended work in the field of experiment and investigation.

C. W. H.

ACCUMULATOR LOCOMOTIVES.

For the purpose of removing excavated material and taking in the cast-iron segments, sleepers, rails, and other



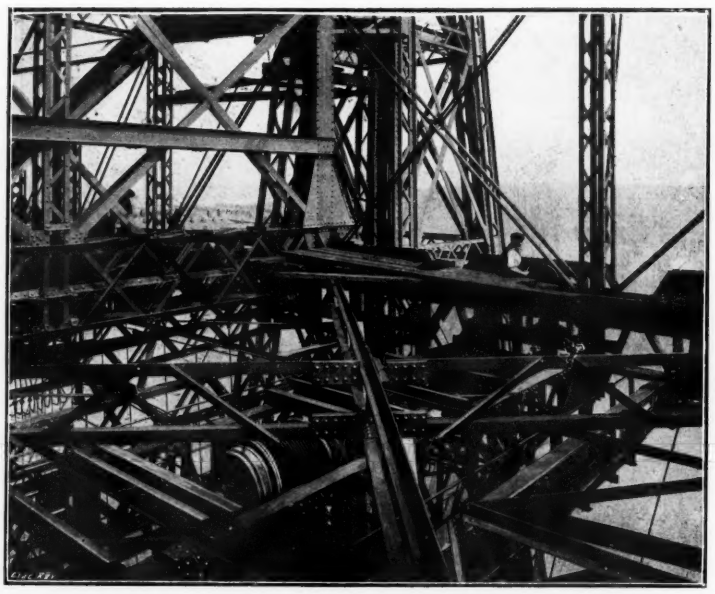
Part of Engine-room, showing Gas-dynamo, Booster and Switchboard.

materi l required in the construction of the Great Northern, Piccadilly and Brompton Tube Railway, two electric locomotives worked by storage batteries are employed.

The locomotive bodies are 50 ft. 6 in. in length over the buffers, and 49 ft. 3 in. over the body, and are constructed of steel with a flooring of Jarrah wood. The floor frames are of channel steel 9 in. × 3½ in. × ½ in., the side sills being 8 in. × 2 in. × ½ in. steel girders. The width is 8 ft., and the height from rail level to tops of cabs 9 ft. 6 in.

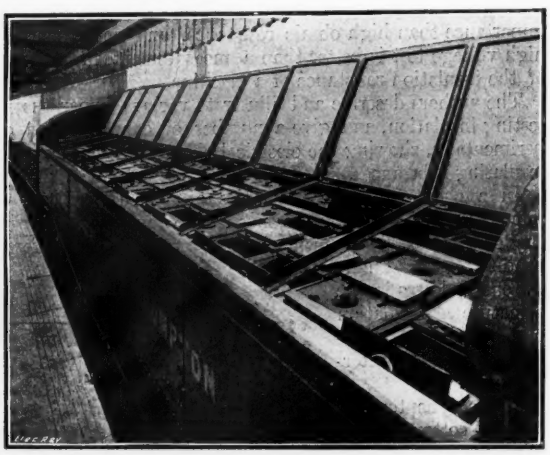
At each end there is a driver's cab fitted with a British Thomson-Houston master controller, and one cab is extended in length so as to accommodate the controlling apparatus, air compressor and air receiver. The cabs are constructed entirely of steel, and are so arranged that they join the portion carrying the battery; the latter rests on the Jarrah wood floor in two divisions, separated by a lattice girder frame, the top of which supports a series of sloping doors covering the batteries. These were supplied by the Chloride Electrical Storage Co., Ltd., of Clifton Junction, Manchester, and consist of 80 cells of the C.W. type, with a normal discharge of 179 amperes, and a maximum emergency rate of 800 amperes, the total available energy being 230,400 watt-hours.

The plates are contained in lead-lined wood boxes with lids. The total weight of each locomotive is about 65 tons, of which 31 tons represents the weight of the batteries. There are two motors, wound for 160 volts. The free running speed

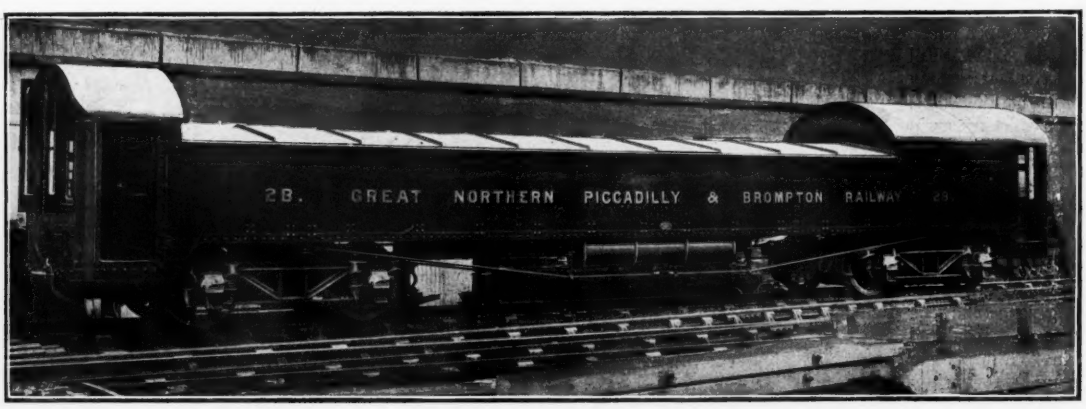


View of Motor and Gearing (Transporter Bridge).

Battery Room (Transporter Bridge).



Accumulator Locomotive with Covers Raised, Showing Battery.



Accumulator Locomotive.

on the level when hauling a load of 60 tons is from 7 to 9 miles per hour.

Each locomotive is fitted with automatic centre-coupler buffers and Westinghouse air-brake. Both were built by Messrs. Hurst, Nelson & Co., of Motherwell, the electric equipment being supplied by the British Thomson-Houston Co., Ltd., of Rugby.

LIGHTING AND POWER NOTES.

(*Concluded from page* 634.)

Morley.—From the Corporation's annual abstract of accounts, it appears that the net deficit on the electricity works for the year ended March 31st last was £1,241, as compared with £957 for the previous year. The balance of profit carried to net revenue account was £605, as compared with £831. Financial charges were:—£981 interest on loans, £76 bank interest and £789 transferred to the sinking fund.

Ossett.—Referring to our note last week, a deputation from the Corporation has since waited upon the B. of T., and the latter has now granted the Corporation sufficient time to put a small plant into operation.

St. Mellon's.—The U.D.C. has appointed a Committee to confer with the promoters of the scheme for supplying energy to Rhymney Valley, which is in the area of the Council's district.

South Africa.—Johannesburg.—Electric power consumers have largely increased, and the T.C. has now approved of the tariff being amended to a minimum rate of 1s. 3d. for each one-third H.P.

East London.—The electrical engineer has been instructed by the T.C. to report:—(1) As to the amount of energy at present available for power purposes; (2) as to the amount of energy for power consumed at the present time; and (3) upon the prospects of the demand for power in the future.

Swanage.—The Bournemouth and Poole Electricity Supply Co. is negotiating with the U.D.C. with a view to an arrangement being come to for the company to obtain a prov. order for lighting and power purposes within the district.

Swinton and Pendlebury.—A new agreement between the U.D.C. and the Lancashire Electric Power Co. for electric lighting has been arrived at. A continuous supply in bulk is to be guaranteed at prices varying, according to demand, from £6 per KW. per annum to £3, plus ½d. for each unit supplied. The maximum price to consumers for lighting is 4d. per unit, for power 2½d., and for public lighting 2½d.

Todmorden.—The new electricity works of the Todmorden Corporation were opened last week. The chairman of the Electricity Committee, Mr. Handley, started the engines, and the Mayoress switched on the supply. The works were designed by Mr. H. Waring, borough electrical engineer, and have cost about £18,000; Messrs. Bruce Peebles & Co. have supplied two dynamos, one of 150 KW. capacity and one 75-KW.; and the cables have been laid by Messrs. W. T. Glover & Co., Ltd., of Trafford Park, Manchester. Consumers will be charged by the Corporation at the rate of 5d. per unit and 1s. per quarter meter rent. In connection with the new works the Council has provided a refuse destructor and buildings at a cost of between £5,000 and £6,000. The destructor is one of Messrs. Meldrum Bros.' well-known type.

Whitehaven.—The T.C., after making various inquiries where free wiring is carried out, has decided not to adopt the system.

Widnes.—At the meeting of the T.C. on October 11th, it was reported that the time limit for carrying out the E.L. order, which had been transferred to the Mersey Electric Supply Co., expired on August 15th. It was also stated that the company was prepared to go forward with the scheme, and to refund the cost of a further application for power to transfer. It was decided to apply for these powers.

Wisbech.—In consequence of a letter received from the L.G.B., the contract with the National Electric Construction Co. has been revoked.

The T.C., on the recommendation of its E.L. Committee, has decided not to abandon its prov. order, but to apply for a further order under the E.L. Acts, amending the order of 1901, whereby the period for carrying it into effect should be extended, and also to enable the Council to transfer the undertaking to some company for the purpose of supplying energy within the borough, and to open fresh negotiations with the National Electric Construction Co. or some other company, the latter to take over the financial responsibility.

TRAMWAY AND RAILWAY NOTES.

Belfast.—The opening of the new electric tramway system has been provisionally fixed for November 14th. That will be only two weeks over the stipulated period for the conversion of the line. There is still a good deal of the overhead work to be done, but extra gangs have been put on to push forward the work as vigorously as possible. The power machinery is well forward, but the building will not be completed for a week or two. Practically 46 miles of track are ready for the electric cars.

Bournemouth.—The completion of the tramways was celebrated on Tuesday by the opening of the line to Christchurch. The line extends 3½ miles through picturesque scenery to the terminus at Christchurch, within a few minutes' walk of the historic Priory Church, and there are 5½ miles of track. The main trunk line of the system, part of which through the centre of Bournemouth is conduit, covers 10 miles, and connects the county borough of Bournemouth with the county borough of Poole and with the ancient borough of Christchurch. The new line to Christchurch will be used chiefly for pleasure purposes, as many thousands of visitors go to Christchurch during the summer months to inspect the interesting Priory Church; and some idea of the number may be obtained from the fact that the admission fees to the church average annually over £700.

The Corporation altered the route previously suggested, carrying the line from the south-eastern extremity of the borough, and crossing the River Stour by a new bridge. The contract for the construction of the permanent way was carried out by Messrs. J. G. White & Co., of College Hill, London, and their price was £39,000, whilst the overhead apparatus was erected by the British Electrical Equipment Co. The bridge is the work of the Yorkshire Hennebique Construction Co., and is 350 ft. in length × 29 ft. 6 in. in width, whilst the widest span is 41 ft., and other spans 25 ft. Tests made two days previously with loaded cars on the bridge proved entirely satisfactory.

The 3½ miles of tramways to Poole cost the Bournemouth Corporation £120,000; 14 miles of tramways in the borough of Bournemouth cost £260,000; and the 3½ miles to Christchurch cost between £50,000 and £60,000, making a total of £440,000. There are altogether 21 miles of tramways. Already from the Bournemouth line, after two years' working, a surplus has accrued of £17,800, after payment of interest and redemption of capital. Last year the receipts were £56,000, or an average of 1s. per car-mile, the expenses £33,592, and the gross profits £22,731, equal to 4·68d. per car-mile. The passengers carried equalled the population of Bournemouth 167 times over.

The opening ceremony on Tuesday commenced at 1.30 with a procession of seven gaily decorated cars, headed by the saloon car, from the Square to Christchurch. The passengers were the Mayors and Corporations of the three boroughs of Bournemouth, Poole and Christchurch, with their wives and other ladies, also representatives from Branksome, a number of officials, and leading electrical engineers, who came by special train from London at the invitation of Messrs. J. G. White & Co., of London, the permanent way contractors for the whole of the Bournemouth system. At Tuckton Bridge, which is a new structure for tramway purposes, the Mayoress of Bournemouth declared the bridge open, and the Mayor of Christchurch (Col. Monckton) welcomed the visitors, and again at Christchurch Town Hall the Mayor of Christchurch extended welcome, which was acknowledged by the Mayor of Bournemouth (Ald. J. Elmes Beale, J.P.) and the Mayor of Poole (Mr. F. W. G. Watkin). The outward and return journeys were accomplished without hitch or accident of any kind on the system, but, unfortunately, when at Boscombe on the return journey, a horse attached to a victoria, in which two ladies were riding, shied and collided with the second tramcar; but the occupants of the carriage, although thrown out, escaped without serious injury. The guests, on arrival at the Square, proceeded to the Winter Gardens, where the Mayor and Mayoress of Bournemouth held a reception, and congratulatory speeches were made. In the evening Messrs. J. G. White & Co. entertained the Bournemouth Corporation and the Corporations of Poole and Christchurch at a banquet at the Grand Hotel, Bournemouth.

Bournemouth-Swanage.—The Poole T.C. has given its consent to a scheme which is about to be promoted for a light railway to be constructed, starting from the County Gates, Bournemouth, and running through Branksome Park and Sandbanks to Studland and Swanage, a distance of some 8 or 10 miles.

Bradford.—The Corporation has determined to lay down a traction cable from the junction of Thornton and City Roads to Whetley Lane at a cost of £1,890, and to provide a booster in connection with it at a cost of £400. In view of an increased demand for motor-trucks, the Corporation has decided to obtain three additional electrical equipments, including 35-H.P. motors, controllers and accessories, at a cost of £185 each from the British Westinghouse Co., Ltd.

Continental Notes.—Holland.—According to the *Kölnische Zeitung*, the Holland-American Construction Co. has been registered at Rochester, with a capital of $1,000,000, for the purpose of constructing light electric railways in Holland. The company has undertaken to build a network of electric lines of a total length of 115 miles. The lines are to traverse the country in a south-easterly direction from the North Sea to the German

frontier. Mr. J. George Kaelber, who has obtained a concession for the construction of the railways, is at the head of the new company, which, in addition to American capitalists at Rochester, Pittsburg and New York, is also said to include Mr. J. H. Lukach, of London.—*Financier*.

Geneva Tramways Co.—The traffic receipts for the month of September, 1905, amounted to 222,367 fr.—an increase over the corresponding period of 1904 of 14,515 fr.

Huddersfield.—From a financial statement relative to the Corporation tramways for the six months ended September 30th, it appears that the capital outlay to date is £414,667. The miles run are 886,791, against 864,306 last year. The income is £38,299, or 10·36d. per car-mile, against 10·38d. last year. The total working expenditure amounts to £19,010, or 5·14d. per car-mile, compared with 5·16d. last year. The gross surplus is £19,288, or 5·22d. per car-mile, the same as last year. The rent of leased lines (Linthwaite) amounts to £603, interest on capital to £6,780, and redemption of debt absorbs £4,875, making a total of £12,258, leaving a net surplus of £7,031, or 1·90d. per car-mile, against 1·61d. last year.

Irlam.—The U.D.C. has decided to approach the Salford T.C. and the South Lancashire Electric Tramways Co. with regard to the provision of electric tramways through the town, connecting Manchester with Warrington and Liverpool.

Leeds.—The tramways permanent-way department is carrying out an experiment which, if successful, will result in the saving of thousands of pounds to the ratepayers, and municipalities will consequently await the result with the keenest interest. The "life" of the tramrail in the days of the horse-drawn trams was computed at 12 or 15 years, but with the accelerated service of electric cars and the increased weight of the latter, the question of renewing the rails frequently has become a serious item of expenditure. Renewals are at present effected by taking up the rail and its concrete bed, but the new scheme aims at superimposing a new rail upon the "foot" when the old one is worn out, without disturbing the concrete. The invention has been brought out by the "Romapac" Co., Leeds, and the rails for the experimental section in Otley Road, Headingley, a distance of about 150 yards, are being supplied by Messrs. Motley & Green. By means of a large and heavy travelling press, the new rail is made to clasp the "foot" on which it lies, and it can be easily removed when desired by cutting away the clasps. If successful the scheme will bring about a great revolution in the laying of tramlines. Details of the system are at present wanting. Obviously, however, the new detachable rail could not be fixed to existing bases, and it will not be possible to convert lines laid on the old system.

Leith.—Recently the current on one of the cars ran to earth, and the bell connected with the circuit-breaker on the car failed to ring. There was a general stoppage for two hours until a careful examination led to the car in question being identified as the cause of the breakdown.

Lincoln.—The electrification of the City of Lincoln tramways has been in progress about four months, and is now nearly completed. The scheme adopted is that known as the G.B. surface contact system, and Messrs. Griffith & Co., engineers, London, have been entrusted with the work at Lincoln, the contract price being £20,000. The agreement contains a clause binding the contractors, in case the system does not succeed within a certain period, to convert the tramways into an overhead trolley system free of cost. Cars, costing each approximately £600, have been built for use on the lines by the Brush Electrical Engineering Co., at Loughborough. They are constructed to carry 22 inside and 36 outside passengers each.

Liverpool-Southport Railway.—Lieut.-Col. Druitt's report to the B. of T. on the accident at Hall Road has been published. The report states that the collision was due to inadvertence in leaving the points in a wrong position, disregard of rules on the part of signalman W. Boote, and to disregard of rules and reckless driving on the part of W. Rimmer, driver of the express. The Inspector remarks on the necessity, at all times, of complying exactly with all rules and regulations; punctuality and fast running must always give way to safety requirements.

Llanelly.—The South Wales Power Co. has under consideration an extensive scheme of electric traction between Llanelly, Burry Port and Loughor.

London.—Hackney.—The B.C. has withdrawn its opposition to the overhead trolley system so far as relates to the Lea Bridge section, which extends from the county boundary to the existing tramway terminus. This is to meet the wishes of Leyton U.D.C.

Over-bridge Tramways.—The question of tramways over the bridges was discussed at a conference held on the 11th inst. at the Guildhall between representatives of the L.C.C. and the City Corporation. The proceedings were private.

Lowestoft.—The T.C. has received from the B. of T. sanction to borrow the following sums in connection with the tramways:—£12,694, permanent way, buildings, &c.; £2,581, electrical generating plant; £2,955, cars.

The assessment of the undertaking has been reduced from £943 to £350.

Macclesfield.—Subject to details of the plans, the supply of energy by the Corporation and the clauses of the proposed Bill being satisfactory, the T.C. has decided to support the East Cheshire Tramways Co.'s scheme for electric tramways from Macclesfield to Hazel Grove, through Poynton and Adlington, and an extension from Cheadle Hulme through Bramall to Poynton.

Manchester.—Two "inner circle" tramway services are about to be started by the Manchester Corporation. The first will be along Whitworth Street (east and west), Deansgate, St. Mary's Gate, Market Street, Piccadilly and London Road, passing the Oxford Road, Knott Mill and London Road railway stations, and going within short distances of the Exchange and Victoria stations. For some time past cars have run from Oxford Street, along Brunswick Street, to Ardwick Green; it is now proposed to continue this service along Higher Ardwick, &c., to Corporation Street. At first the cars will, from this point, run to Albert Square, and thence to Oxford Street, completing the circle. The committee has in view the opening of another route from the end of Miller Street, and Parliamentary powers are to be sought in the coming session for a line down New Bridge Street, connecting with the Bury New Road line. These circular routes will be a great convenience to people wanting to reach the railway stations, and may remove the necessity, which some people consider to exist, for a "tube" line underground. The Tramways Committee has decided to increase the number of covered double-decked cars, being satisfied that, for all-round purposes and the Manchester weather (especially in winter time), they are the most serviceable, and produce a better financial return. At present about 24 of these cars, all of the largest size, are in use, and in a week or so the number will be doubled. Before the end of the year about 75 covered cars will be available for public service. The committee has adopted a suitable cover for the smaller cars, by way of experiment.

The much-delayed Manchester and Altrincham extension, through Sale and Timperley, is likely soon to be begun, and hopes are entertained that next spring may witness the opening for traffic. The widening of Crossford Bridge across the River Mersey has been arranged. Up to that point the Stretford lines are already carried, and those to connect with Sale and Altrincham, on the Cheshire side, will be laid concurrently with the bridge improvement. From a point on the main road a branch line will be carried along Northenden Road as far as the Industrial Schools, and ultimately to Northenden village and Gatley, where a junction will be effected with the Stockport system of tramways.

The T.C. proposes to promote a Bill authorising the construction of additional tramways in nine streets in the city to Moss Side Longsight, Clayton and Moston.

Midlothian.—The application of the National Electric, Construction Co., Ltd., for consent to the construction within the county of Midlothian of an electric tramway from Edinburgh to Queensbury, has been remitted back to the Suburban Committee of the County Council.

Perth.—On Tuesday and Wednesday last the electric tramways were inspected by Mr. Trotter, on behalf of the B. of T. It was understood that the results of the examination were satisfactory.

The T.C. has decided against running cars on Sundays.

Ramsgate.—On Friday last, Colonel von Donop, Inspector of the B. of T., resumed the inquiry into the accident on August 3rd, when a car, with several passengers, fell over a cliff. The inquiry had been adjourned for the attendance of the driver of the car, L. W. Lloyd, who went over the cliff with the car, and was seriously injured. Lloyd, now called, said the car suddenly gained impetus at the summit of the hill, acquiring a pace of from 6 to 10 miles an hour. He tried his utmost to use the sand-box apparatus, but not a particle of sand fell on the line. He thought he might have checked the car and possibly have brought it to a standstill in another few yards, but it left the lines, and he was thrown off and recollected nothing more. The accident was not caused by his too suddenly applying the brakes. He could not account for the wheels skidding. The sand-box apparatus was useless at places where the lines curved, because the sand did not then fall on the rails. A conductor, named Woodward, who examined the rails after the accident, said he found no trace of any sand having been put on the lines at the spot. The Inspector announced that the inquiry was closed.

Sandgate.—With reference to the proposed scheme of electric tramways from Folkestone to Hythe through Cheriton and Sandgate, the U.D.C. has decided to report favourably to the other local authorities in the area on the scheme of the National Electric Construction Co.

Southend-on-Sea.—The T.C., on October 10th, decided to extend the electric tramways to Shoeburyness. The entire cost will be £67,250, but the exact sum chargeable to the light railways department will be £51,250, the balance being for road improvements, &c.

Tipton.—The U.D.C. has rejected the plans submitted by the Tramway Co. in reference to the reconstruction and electrification of the line between Dudley and Wednesbury, and has requested the company to prepare amended plans which the Council can accept. A committee has been formed with executive powers to see that the track is properly laid and to act in conjunction with the surveyor (Mr. Jewkes, who is to act as engineer on behalf of the Council) in settling any matters of dispute that may arise.

Wilmslow-Cheadle. — On sentimental grounds, *i.e.*, the spoliation of the district, noise, dust and turmoil, and the introduction of trippers, Wilmslow U.D.C. has rejected a recommendation approving of the scheme of electric tramways between the town and Cheadle.

Handforth U.D.C. has also disapproved of the scheme on the same grounds, while Cheadle and Gatley U.D.C. has decided to take such steps as may be deemed necessary to oppose the scheme.

TELEGRAPH AND TELEPHONE NOTES.

French Cable Co.—According to a Paris dispatch to the *Morning Post* from their correspondent, the French Government are to help the French Cable Co. in their financial difficulties. Some of the cables are in urgent need of repair which the company is at present unable to effect. In view of the national importance of the enterprise, the Government is now preparing an arrangement under which the company's capital is to be first reduced, and subsequently increased by the issue of new shares guaranteed by the State. The lines are to become Government property after a certain time, but will still be worked by the company. The scheme will be submitted to Parliament early in the coming autumn session.

Japanese Telegraph Restrictions Withdrawn.—The Great Northern Telegraph Co., Ltd., notify that they have been advised by the Japanese Telegraph Administration that all restrictions imposed upon telegrams exchanged with Japan, Korea and Formosa, as well as the military censorship at Nagasaki, have been withdrawn from 16th inst.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chifu	Mar. 9, 1904	
Jamaica-Colon	Jan. 5, 1905	
Cadiz-Teneriff	July 20, 1905	
Cotonon-Grand Bassam	Oct. 4, 1905	
Landlines.		
Puerto-Barrios	July 28, 1902	
Kertch-Soutchoum	Sept. 27, 1904	
Communication with Brazil *via* Galveston	July 18, 1905	

Telephone Communication with the Continent.—According to a letter printed in the Liverpool Chamber of Commerce *Journal*, the Postmaster-General says that direct telephonic communication between Liverpool and Antwerp is not at present satisfactory, and that he understands the local exchange system at Antwerp is being reconstructed, and that the work will probably be completed in two years' time.

Similarly, the Postmaster of Liverpool states that, after September 1st, the restriction of the service of Continental telephony to Post Office subscribers only will be removed, and that the National Telephone Co.'s subscribers connected with the Central Exchange will, from the date mentioned, be permitted to speak to certain places abroad.

Wireless Telegraphy.—The ss. *Inkosi*, of Messrs. John T. Rennie, Son & Co.'s Aberdeen Line, which sails for Durban, Delagoa Bay, and East African ports, has just been fitted with the Marconi system of wireless telegraphy, and the ss. *Inanda*, of the same line, will be similarly fitted before she leaves on her next trip. These are the first passenger steamers going into southern latitudes to be so fitted. At present it will only be possible for communication to be kept up as far as Las Palmas, except when the vessels are in touch with his Majesty's ships at sea or at Simons Bay.

As a result of the experiments in wireless telegraphy which have been in progress for three years, perfect communication has been established between the Eiffel Tower and Châlons, Verdun, and Sainte Menehould.

A local paper says that the Marconi Wireless Telegraph Co. have decided to close their Chelmsford station and works, and the whole of the staff and plant will shortly be transferred to Dalston, London.

CONTRACTS OPEN AND CLOSED.

OPEN.

Austria.—The municipal authorities of Klattau, Bohemia, are about to invite tenders for the establishment of a central electric lighting station in the town.

Bridlington.—November 1st. One 200-KW. steam dynamo, pipework and switchboard extensions for the Corporation. See "Official Notices" October 6th.

Clacton-on-Sea.—November 6th. Gas engines and dynamos, switchboard, mains, battery, meters, crane, and buildings for electricity works, for the U.D.C. See "Official Notices" to-day.

Dundee.—October 25th. The Harbour Trustees invite offers for the supply and erection at the Craig Pier of three electric arc lamps and three electric incandescent cluster lights, with the necessary wiring, switches, &c. John Thompson, Harbour Engineer.

Edinburgh.—October 23rd. Arc lamps and posts for the Corporation. See "Official Notices" October 13th.

Greenwich.—October 24th. The Guardians invite offers for repairs to the batteries at their installation at Grove Park Workhouse, Lee, S.E., and also for maintenance of same. Particulars can be obtained on application to the Master.

London.—October 25th. Wiring and fittings for the electric lighting of the Bandstand in Victoria Embankment Gardens for the L.C.C. See "Official Notices" October 6th.

Mussoorie (India).—October 23rd. Supply and erection of steel power pipes, water motors, alternators with exciters, switchboards complete, transformers, induction motors, pumps, workshop machines; also bare copper overhead mains, insulators, and lightning arresters, arc and incandescent lamps, telephone equipment, workshop tools and general stores. See "Official Notices" July 14th.

Stoke-upon-Trent.—November 1st. Re-wiring portion of the Workhouse and Cottage Homes, and replating the battery, for the Guardians. See "Official Notices" October 13th.

Spain.—November 27th. The Spanish Ministry of Public Works is inviting tenders until November 27th, for the construction of an electric tramway in Madrid, from the Ronda de Valencia to the Glorieta del Puente de Toledo. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Obras Publicas, Madrid.

Tynemouth.—November 2nd. One 165-KW. traction dynamo for the Corporation. See "Official Notices" October 13th.

CLOSED.

Ashton-under-Lyne.—The T.C. has accepted the following tenders:—

Messrs. Dick, Kerr & Co., Ltd., Belliss engine coupled to Preston dynamo.
Messrs. Babcock & Wilcox, Ltd., water-tube boiler.
Messrs. W. B. Haigh & Co., Sugden superheaters.

Bexley.—The U.D.C. has accepted the tender of the British Westinghouse Co. for the supply of a 50-KW. transformer, at £65 10s.

Bradford.—A new shaft for the Corporation's No. 10 Willans engine has been ordered from Messrs. Willans and Robinson, at £266.

Burslem.—The T.C. has accepted the tender of Mr. E. M. Evans for wiring the Town Hall, baths, Surveyor's offices and the fire station, for the electric light, at £318 10s. 6d.

Dewsbury.—The Joint Hospital Board has accepted the tender of Mr. G. J. Hood, of Dewsbury, for the supply and fixing of electric wall plugs with hand lamps.

Exeter.—The T.C. has accepted the tender of Messrs. Hubber & Son, of Exeter, to install the electric light at the Higher and Lower Markets, at £130 10s.

France.—The French Post and Telegraph authorities in Paris have just given out contracts as follows:—La Compagnie des Trefileries de Havre, 100 tons of bronze wire, 2⅔ mm. diameter, at 309½ fr. per ton; and La Compagnie Generale d'Electricité, Paris, 130 tons ditto, 2½ mm. diameter, at 314 fr. per ton.

Glasgow.—The Corporation has placed an order with Messrs. J. H. Walton & Co., Newcastle-on-Tyne, for a "Simplex" self-acting tramway rail grinder.

G.W. Railway.—According to the *Railway Times*, the Great Western Railway Co. and the Metropolitan Railway Co. have awarded contracts to the Metropolitan Amalgamated Railway Carriage and Wagon Co., Birmingham, for the new rolling stock required for the Hammersmith and City Railway, which is now being converted to electric traction. The electric motors and equipment will be supplied by the British Thomson-Houston Co. There will be 20 new trains, viz., ten for the Great Western Railway Co. and ten for the Metropolitan Railway Co., each train consisting of six coaches.

Hammersmith.—The B.C. has accepted the tender of Messrs. J. & A. Law, of Glasgow, at £57 10s., to extend the hand-rail around the switchboard at the generating station.

London.—Islington.—Thirteen tenders were received by the Lighting Committee for the supply of bituminous nutty slack coal for the generating station. The following were accepted:—

Phillips & Co., Ltd., 10,000 tons, 2s. 6d. price at pit's mouth, 9s. 3d. price delivered.
Charrington, Sells, Dale & Co., 3,000 tons, 2s. 5d. price at pit's mouth, 9s. 1d. price delivered.

Stoke Newington.—At the meeting of the B.C. on Tuesday, instructions were given for orders to be sent to Messrs. Bruce Peebles & Co., Ferranti, Ltd., and the Electrical Power Storage Co., Ltd., to proceed with their contracts in respect of sub-station plant, switchboards and battery.

The Metropolitan Asylums Board received the following tenders on Saturday for electric lighting, power distribution, fire alarms and telephone installation, &c., at the South Eastern Hospital and Ambulance Station:—

Bromley & Batstone, 24-26, Holborn, E.C. ..	(accepted)	£4,894
Buchanan & Carwen, 64, Victoria Street, S.W. ..	..	5,495
Foote & Milne, Ltd., 66, Victoria Street, S.W. ..	..	5,535
Wenham & Waters, Ltd., Croydon	..	5,974
Alliance Electrical Co., 23, Grafton Street, W. ..	..	6,027
Glover, F. A., & Co., Ltd., Vine Street, Clerkenwell, E.C. ..		6,500
Drake & Gorham, Ltd., 66, Victoria Street, S.W. ..	..	6,590
Belshaw & Co., 53, Victoria Street, S.W.	..	6,894

(Engineer-in-Chief's estimate, £5,100.)

At the Board's meeting on Saturday the Works Committee reported having accepted the following tenders:—

Repairs and renewals to electric storage battery at Grove Hospital, Pritchetts and Gold, £25.
Re-arranging and re-wiring internal telephones at Head Office, Julius Sax and Co., £42 15s.
Rectification of electric and ordinary bell installations at Western Ambulance Station, ditto, £19 10s.
Replacing negative plates in storage battery at Grove Hospital, Pritchetts and Gold, £42.

Messrs. A. W. Penrose & Co. have received the contract for the following for the forthcoming new Liberal organ, the *Tribune*:—One passenger lift; one goods lift; one 5-ton crane; one newspaper conveyor capable of delivering 180,000 copies per hour; the main switchboard; 16 motors; and, including the wiring, about 500 lights.

Oldham.—Messrs. S. Dixon & Son, Ltd., have received an order for one Turner's patent automatic point controller, as sample, from the Oldham Corporation Tramways Department.

Sydney, N.S.W.—The City Council has placed an order with the A.E.G. for the supply of 600 electricity meters.

Taunton.—The T.C. has accepted the tender of Messrs. Allen & Son, of Taunton, for the supply of a tank for the electric light works, at £72 5s.

Victoria (Vancouver).—The City Council has awarded the contract for the supply of electrical plant for street lighting purposes to the Hinton Electric Co., the plant to be of the Canadian G.E.C. manufacture. The machinery is to be delivered within 75 days after signing the agreement, and it is expected that the new plant will be in operation this winter. The figures were:—Canadian General Electric Co., $9,075, (Hinton Electric Co.) Canadian Westinghouse Co., $9,038. The tenders for wire were:—Hinton Electric Co., $22 per 100 lb. (accepted); the Canadian G.E. Co., $22 per 100 lb.; E. G. Prior & Co., $24.80 per 100 lb.

Wolverhampton.—The Electricity Committee has accepted the tender of the Anglo-Russian Oil Co. for the supply of oil for two years.

FORTHCOMING EVENTS.

To-day's Events.—First Smoking Concert of the Electro-Harmonic Society. At 8 p.m. Lecture at Olympia on "Telephones," by Mr. F. Gill.

Saturday, October 21st.—At 7.30 p.m. Glasgow Technical College Scientific Society. Dr. H. Dyer on "The Training and Work of Engineers in Some of their Wider Aspects."

Tuesday, October 24th.—At 8 p.m. Electrical Contractors' Association (London). Mr. C. J. Beaver on "Rubber used in the Insulation of Cables and Wires."

Wednesday, October 25th.—At 8 p.m. Tramways and Light Railways Association. "On Roller Bearings," by Mr. T. W. How.

Friday, October 27th.—At 6.30 p.m. Institution of Electrical Engineers (Glasgow). Fourth Annual Dinner at the Grosvenor Restaurant.
At 8 p.m. Junior Institution of Engineers. Annual General Meeting and First Meeting of the Incorporated Institution.

Tuesday, October 31st.—Tramways and Light Railways Association. Visit to Brimsdown power station and sub-stations of the North Metropolitan E.P. Supply Co., and the Metropolitan Electric Tramways system. Train at Liverpool Street at 1.23 p.m.

Tuesday, November 7th.—At 8 p.m. Institution of Civil Engineers. Inaugural Address by the President, Sir Alexander R. Binnie. Presentation of the Council's Awards, and Reception in the Library.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued:—

Monday, October 23rd.—"A" Company, meeting at Headquarters at 8 p.m.
Tuesday, October 24th.—Medical examination and enrolment of recruits at 7 p.m
"B" Company, meeting at Headquarters at 8 p.m.
Thursday, October 26th.—"C" Company, meeting at Headquarters at 8 p.m.
Friday, October 27th.—"D" Company, meeting at Headquarters at 8 p.m.

J. H. S. Phillips, Captain E.E.R.E. (V.)
For O.C.E.E.R.E. (V.)

NOTES.

Gas v. Electricity for Street Lighting: Gross Misstatements on the part of the Gas Interests.—The Croydon County Council has before it a proposal that the local gas companies shall be allowed to make an experimental installation of improved incandescent gas lighting, which they claim is much cheaper than electric arc illumination. A resolution relating thereto was before the Council at its last meeting, when Alderman D. B. Miller, as chairman of the Lighting and Electricity Committee, made his reply. He claimed that light for light, and candle-power for candle-power, the Corporation could thoroughly hold their own. As Liverpool had been quoted as a place where gas had been substituted for electric light, the speaker read a letter from the Liverpool electrical engineer, who said:—"I have never been able to trace the source of the statements that at Liverpool incandescent gas lighting has replaced the electric light. It is about nine years ago since the first electric arc lamps were installed by the Corporation for lighting some of the principal streets of this city, and this arc lighting has, from time to time, been considerably extended, and never from the commencement has any electric lighting been discontinued and replaced by gas." Then there were other cases of statements being made at variance with facts in order to make out a case for gas. Alderman Miller next read a letter from Bradford, stating that there were no instances there of public street electric lamps having been discarded for gas. Again, as regards Islington, the letter from that authority ran as follows:—"I beg to say that gas has never been substituted for any portion of our electric street lighting system, and I can only suggest that this is one of the many deliberate misstatements promoted by the gas companies throughout the country. At the present time we have nearly 500 arc lamps in the streets of the borough, and 30 are being erected, and will be connected within the next three weeks. Of course, we have from time to time carried out experiments in various side streets with half-a-dozen lamps at a time of the Nernst or incandescent variety; also with some premature flame lamps, which we kept going for a few weeks and then removed as unsatisfactory, and it is possible the gas company noticed the removal and worked up a case accordingly." In reference to the City of London, Alderman Miller said that the type of electrical arc lamp in existence there was obsolete. He proceeded then to read a letter from the St. James's and Pall Mall Electric Light Co., showing that though the gas company made a determined effort to take the contract from them, they had secured a fresh one with the Westminster City Council for five years on an undertaking, which they (the company) had given, that the candle-power of each lamp should be raised from 700 to 900. Alderman Miller reminded the Council that on 24 occasions they had voted unanimously for arc lamps, and of the success of their electricity works in giving £3,000 for the relief of the rates and building up a large reserve. The latter also belonged to the ratepayers, and would not go to a large company to be disbursed in the shape of heavy dividends. At this point Alderman Miller was interrupted by a time rule, and the debate stood adjourned till 23rd inst.

The New Graving Dock at Southampton.—The new graving dock of the L. & S.W. Railway, when in use, will contain 85,000 tons of water, which, by means of two 48-in. centrifugal pumps, manufactured by Messrs. Gwynne, of Hammersmith, can be emptied in 2½ hours. The pumps are driven by direct-acting vertical engines, to which steam is supplied from a battery of seven boilers of the locomotive type. A 12-in. centrifugal pump is also installed to deal with any water that may perchance leak in when the dock is empty. The same boilers will also serve to drive the six sets of dynamos installed in a new electric power station, built on the westerly side of the dock, to replace a structure which is now inadequate for the general electrical requirements of the docks. A plant for condensing and utilising the exhaust steam has been laid down, and the waste gases from the boiler furnaces pass through special flues to a chimney shaft rising 100 ft. above ground level. Mr. D. Drummond, the company's chief mechanical engineer, has designed the whole of this new machinery. The dock is fitted with every modern appliance for convenient working, including an electric crane constructed by Messrs. Stothert & Pitt, of Bath, to lift no less than 50 tons at a radius of 87 ft. Weighing 300 tons, and travelling upon 20 wheels along the east wall of the dock, this crane—the largest in the world—will be especially useful for the handling of heavy material required in merchant steamers, as well as for the removal of guns in the event of the dock being used by any of His Majesty's ships.

The Electric Furnace at Olympia.—We learn that the 1,000-ampere electric furnace which is being exhibited at the Olympia Exhibition by Messrs. Marryat & Place has been purchased by the National Physical Laboratory, Teddington.

Institution Notes.—Rugby Engineering Society.—The programme for the 1905-6 session includes the following lectures and papers:—

"Protection from Electric Shock," by J. Sugden, Member, with practical demonstration of the necessary treatment after a shock.
"Electric Switchgear," by J. Whitcher, Member.
"High Lift Pumps," by P. A. Mossay, Member.
"The Testing of Metals," by T. S. Dick, Member.
"The Design of a large Shop for Electric Manufacturing," by F. J. Sharr, Member.

And a series of four papers on the "Economical Distribution of Energy from Coal," as follows:—

"The Generation of Steam," by J. Brierley and T. Robertshaw, Members.
"The Conversion of Steam Energy into Mechanical Energy," by E. R. Briggs and A. E. Reynolds, Members.
"The Conversion of Mechanical Energy into Electrical Energy," by F. H. Clough, Member.
"The Transmission of Electric Energy," by C. McCarthy Jones, Member.

Lectures will be given by—
Mr. W. F. Parrish, chief of Technical Department, Vacuum Oil Co., on "Lubrication."
Mr. J. M. Gledhill (of Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd.), on "High-Speed Steel."

The following is a list of premiums which have been awarded:—

Hopps, Bernard.—For paper entitled "Notes on Automobiles," 1903-4. "Willans" Premium.
Millington, W. E. W.—For paper entitled "Some Cases of Deflection of Beams due to Bending," 1903-4, "B.T.H." Premium.
Brown, G. M.—For paper entitled "The Application of Electric Power in Collieries," 1904-5, "B.T.H." Premium.
Watson, R.—For paper entitled "Pattern-making," 1904-5, "B.T.H." Premium.

Tramways and Light Railways Association.—The Official Circular for October contains a notice of a lecture by Mr. T. W. How, F.R.G.S., "On Roller Bearings," which will be given in the Lecture Room of the Society of Arts, at 8 p.m., on Wednesday, October 25th, 1905. The chair will be taken by Mr. A. L. C. Fell, M.I.E.E.

Mr. A. L. C. Fell, M.I.E.E., will give a lecture "On Brakes," in the Theatre of the Institution of Civil Engineers, Great George Street, London, S.W., at 8 p.m., on Wednesday, January 10th, 1906. The chair will be taken by Mr. C. R. Bellamy, Assoc. M.Inst.C.E. (Vice-President).

Visits are to be paid to the power station of the North Metropolitan Electric Power Supply Co.; to the system of the Metropolitan Electric Tramways; the Holborn to Strand Subway (when an all-steel car will be inspected). A series of lectures has been arranged, including one by Mr. S. Sudworth "On the Up-keep of Tramway Electric Motors;" one by Dr. Goldschmidt, "On the Thermit System of Electric Welding;" and another "On Paving of Roadways."

Nottingham Guild of Mechanical and Electrical Engineers.—At the opening night of the Session (Tuesday, October 17th) Dr. F. H. Jacob, M.D., will lecture on the "Röntgen Rays," "Finsen Light," &c., assisted by Mr. F. Mears, electrician to the Nottingham General Hospital.

The following gentlemen has been elected on to the council, &c., for the ensuing 12 months:—Chairman, Mr. E. Goddard; vice-chairman, Mr. W. Wigley; Messrs. J. Balmford, H. Bull, C. Curwood, F. G. Grubbe, J. Kent, J. Paine, A. Pyne, H. Sanders, S. Smith, G. Smith, W. Vickerstaffe, J. Wood, J. Whysall, and W. Wollatt. Trustees: Mr. G. Head and Mr. C. Wessey; treasurer, Mr. J. Carlton; auditors, Messrs. W. Harlow and W. Wheatley; registrar and hon. sec.. Mr. H. E. Newstead; recorder, Mr. W. Gill. Mr. F. A. W. Taylor is secretary.

The Manchester Association of Engineers.—This Association celebrated the opening of its fiftieth session on Saturday last by a conversazione at the Municipal School of Technology. There was a gathering of about 600 members and their friends. The Association is the oldest of its kind in the provinces. It was established in 1856, and at the end of the first decade had 114 members. Amongst its earlier objects was the making of grants to members in case of total disablement, and there was also provision for funeral allowances. Largely through the influence of Sir William Mather, an ex-president, whose connection with the Association dates from 1864, the meetings became devoted exclusively to the discussion of purely technical subjects. The number of members now exceeds 500. By a change in its constitution, made three years ago, the financial benefits above-mentioned (intended mainly for foremen and draughtsmen) were restricted to the members then on the roll, and to-day only about 230 have that advantage. Many members, on the change being made, voluntarily relinquished their claims. The disposable funds of the Association now amount to £5,514. The Council has under consideration the question of widening the basis of membership, so as to admit students and graduates. The Association has long closely identified itself with the promotion of technical education, and in pursuance of a scheme now in force, Manchester employers grant permission to qualified apprentices to attend technical classes all day each Monday. The president for this, the Jubilee year, is Mr. Robert Matthews, of Armstrong, Whitworth & Co., Ltd. His inaugural address will be given during the present month. Papers are to be read and discussed during the session by Mr. Thomas Ashbury, Mr. Samuel Rendel, Prof. John Goodman (Leeds), Mr. G. F. Metzger, and others. At the conversazione last Saturday the engineering, electrical and other departments of the School of Technology were thrown open for inspection.

Gas Lighting and Public Health.—"People who are afraid of gas, and will not introduce it into their houses, may all the same be suffocated by it," said Prof. Oliver last night at the Institute of Public Health, where he lectured on "The air we breathe in the house, the factory, and the mine." "It is interesting to remember," he said, "that where coal-gas, which has escaped from a main, finds its way into a house, it loses its odour in percolating through the soil, and is therefore the more dangerous. A victim would not be awakened, but would sleep on, and become more and more deeply narcotised. During the first four years that water gas was introduced into Dublin, there were 10 cases of gas poisoning, seven of which proved fatal. In one of the houses in which the inmates were poisoned, no gas had been laid on, and yet one of the sufferers died."—*Daily Express.*

Widnes and Runcorn Bridge.—At the annual meeting of the Widnes and Runcorn Bridge Co. on Tuesday, at Liverpool, Sir John Brunner, M.P., said the difficulties which had been encountered in the enterprise, and had prevented the transporter bridge being worked for some time past, would be overcome by practical experience. After considering the report of the engineers, he had telephoned to Widnes to start the car running for traffic at once, and this had been done. While the authorised capital and borrowing powers might be exhausted, he did not think any creditor need be under the least anxiety, because there was not a shadow of doubt that the board would find the money to pay all that was due.

A description of the bridge appears elsewhere in this issue.

The Berlin Strike Ended.—The *Times* Berlin correspondent says that on 14th inst. both sections of the strikers in the electrical industry had decided to resume work upon the masters' terms, which include a 6 per cent. increase of wages. The final resolution in favour of the resumption of work was carried by a majority of 138 votes to 91, and the men will accordingly return to their employment on Monday without suffering any prejudice to their position. The consideration that continued resistance would throw a further 20,000 men out of employment materially contributed to the surrender of the strikers at the last moment.

An Electrically-driven Barge.—The *Zeitschrift für Elektrotechnik* gives some interesting particulars of a 1,100-ton electrically actuated barge, which has been employed in transporting petroleum on the Volga between Rybinski and St. Petersburg (a distance of about 680 miles) for the past three months. The barge is an iron one, 74 metres long, 9·7 m. wide, and with a draught of 1·8 m. It is fitted with three propeller screws, each driven by its own direct-current motor situated at the stern of the boat. There are three generating units, each consisting of a 3-cylinder vertical Diesel engine driving a direct current dynamo by means of a flexible coupling. These are situated in the centre of the barge. The motors are separately excited from other dynamos mounted on the same shafts as the main dynamos. These exciting dynamos are also used for the lighting of the boat, and for driving pumps, a windlass, &c. The speed of the motors is regulated by varying the voltage of the generators, for which purpose a controller is fitted on the bridge by means of which the speed of the propellers can be varied between 30 and 90 r.p.m. About 12 seconds are required to change from full speed ahead to full speed astern.

The electrical installation was carried out by a Swedish firm at a cost of about £6,000. If ordinary steam engines had been employed the cost would have been reduced to about £4,300, but in view of the improved efficiency, and of the low cost of petroleum, the Diesel engines will very soon repay their additional first cost, and at the same time the carrying capacity of the barge is increased by some 10 per cent. The Diesel engines consume crude petroleum of a calorific value of 11,000 calories per kg., obtainable at St. Petersburg at 45 fr. per ton. The barge is furnished with reservoirs at stem and stern of a total capacity of 56,000 litres, whilst the consumption of oil for the complete outward and return journey is about 16,000 litres. In case of emergency the propellers can be worked directly by the Diesel engines.

Dinner at Olympia.—On Tuesday last a large number of the exhibitors and their friends dined together at Olympia, and congratulated each other on the great success of the Electrical Exhibition. The Executive Committee, the managers and engineers, all received their meed of praise, and the Chairman, Mr. E. Cunliffe Owen, came in for a special share.

It was stated that 104,000 visitors passed through the turnstiles during the first three weeks, and that probably one-half of the rental of the stands would be returned to the exhibitors.

Appointments Vacant.—A resident engineer and a shift engineer is required for the Birmingham Corporation's new generating station, at a salary of £300 and £150 respectively, and a sub-station superintendent, under the same authority, at £250; electrical foreman for the East Indian Railway Co., Rs. 300 per month.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*]

Central Station Engineers.—At the last meeting of Hackney Borough Council, a letter was read from Messrs. Sheffield Bros., stating that their warmest thanks were due to Mr. Robinson, the electrical engineer, for his "very splendid and successful exertions" in connection with the electric power installation at the firm's wood-working mill. Many experts who had gone over the mill were unanimous in their praise. On behalf of the Lighting Committee, it was stated that this was only one of many instances of the admirable work done by Mr. Robinson in the way of inducing manufacturers to install electric power and so promoting the interests of the undertaking.

Mr. Ed. Fenton, who has been for the last four years student at the York Corporation Electricity Works, has been appointed junior assistant mains engineer by the Electricity Committee.

Mr. H. N. Newcomb, of the South London Electric Supply Corporation, has been appointed to the position of engineer-in-charge at the Wimbledon Electricity Works.

At a meeting of Devonport T.C. on 12th inst., Mr. Banbury presented the minutes of the Electricity Committee, which recommended that the salary of Mr. Spark, the engineer, be increased from £275 to £300 per annum, and that of Mr. Stamp, his assistant, from £140 to £150 per annum, as from October 1st, 1905. The chairman of the Committee quoted figures to show that the undertaking was progressing, the sale of units being greater than last year, despite a great decrease in the total taken by the Devonport and District Tramway Co. He referred to the excellent work done by Mr. Spark, who had by his energy and skill placed the undertaking in its present satisfactory condition. In Plymouth the engineer was paid £500 a year, and the first assistant £250. The salaries paid in towns similar to Devonport showed that they would not be acting extravagantly if the increase were granted. After discussion, the recommendations were defeated by 24 votes to 15.

By nine votes to six, Doncaster T.C. has rejected a proposal to increase the salary of Mr. E. S. Rayner, electrical engineer, by £50 per annum, with a further increase a year hence. The immediate increase of £50 to £350 per annum was not objected to by the Council.

Mr. F. A. Bond, chief engineer to the Heston and Isleworth U.D.C., and son of the late Rev. Dr. Bond, LL.D., was married on Thursday, October 12th, at the Barnstaple Parish Church to Miss Jessie M. Berry, daughter of Mr. Alderman Berry, of Barnstaple, a former Mayor of the borough. The Electric Lighting Committee of the Council presented the bridegroom with a handsome marble clock and side pedestals, and the staff gave him an artistic floor standard electric lamp, and also gave the bride a pretty gold bracelet. The honeymoon is being spent at Bournemouth.

Mr. R. Jones, shift engineer to the Southend Corporation Electricity Works, has been appointed station engineer to the U.D.C. of Dartford Electricity Department. Before leaving Southend, Mr. Jones was presented with a number of presents from members of the works staff. Mr. Jones commenced his new duties on Monday, 16th inst.

It was announced at Nelson early in the week that the borough electrical engineer, Mr. Fraser, had sent in his resignation, and that the Electricity Committee recommended the Town Council to accept it.

Tramway Officials.—Mr. T. Stirk, assistant traffic superintendent of the Bradford Corporation Tramways, has been promoted to the position of traffic superintendent at £200 per annum. It had been the intention of Councillor Jas. Hill, chairman of the Bradford Tramways Committee, to retire from public life at the termination of his term of office in the Council this month, but he has been pressed to accept election as an alderman, a vancancy having just arisen, and there is little doubt that he will be elected, though Labour representatives have intimated publicly that they will vote against him.

General.—The Ilford U.D.C. has appointed Mr. S. A. Lovick, of Battersea, as E.L. canvasser.

In future, the business address of Mr. C. C. F. Monckton, electrical engineer to the Government of Trinidad, will be 53, Victoria Street, Westminster.

The executive of the Edinburgh Association of Science and Art has awarded a bronze medal to Mr. T. Cuthbert Day, Edinburgh, for his paper on "The X-Rays," and a similar award to Mr. John Ritchie, engineer, Edinburgh, for his paper on "Electrical Hoisting and Conveying Machinery."

Mr. George M'Neill, who has been at the Oban Electrical Supply Station for about two years, has received an appointment in the works of the Kosmoid Electrical and Engineering Co., Ltd., Dumbartonshire.

Mr. Albert Moorhouse, electrical engineer for the past three years at the Burnley Workhouse, has been successful, out of 440 applicants, in securing a similar appointment in connection with the Willesden Infirmary.

Obituary.—We learn with very deep regret of the death of Mr. Alfred Morcom, M.I.N.A., M.I.C.E., M.I.M.E., chairman of Belliss & Morcom, Ltd., of Birmingham, who passed away on 16th inst. at his residence, Trelawne, Edgbaston, after a short illness.

The *Leeds Mercury* says that Mr. Harry Rayner, electrical engineer, Cleckheaton, died on Tuesday last week at Lower Dunsforth, near Boroughbridge, from injuries sustained through his motor-car overturning on Thursday, September 21st.

NEW COMPANIES REGISTERED.

Car Trust Realisation Co., Ltd. (86,106).—This company was registered on October 11th, with a capital of £25,000 in 5s. shares, to acquire the assets of the Car Trust Investment Co., Ltd. (incorporated in 1888), to adopt a certain agreement, to develop, turn to account and realise the property therein mentioned, as and when favourable opportunities occur, to act as financiers, railway and tramway proprietors, &c. The first subscribers (each with one share) are:—A. Shepherd, 63, Castle Street, Edinburgh, W.S.; R. D. Balfour, Basildon House, Moorgate Street, E.C., stockbroker; E. Scott Murray, Sun Life Office, Threadneedle Street, E.C., gentleman; A. Mortimer, 1, Paper Buildings, Temple, E.C., barrister; L. E. Mortimer, Woodhatch, Reigate, merchant banker; H. G. Palmer, 1, Gresham House, E.C., merchant banker; W. Berry, 1, Gresham House, E.C., gentleman. No initial public issue. The number of directors is not to be less than two nor more than five; the first are R. D. Balfour, R. H. Glyn, L. G. Mortimer, A. Shepherd and C. A. Scott Murray; qualification, £25 shares or £1,000 income bonds; remuneration, £850 per annum, divisible. £250,000 4 per cent. redeemable debenture stock and £737,500 5 per cent. redeemable income bonds have been, or will be, created. The purchase consideration is £1,012,500, payable (*a*) as to £250,000 by satisfying the balance of £250,000 debenture stock of the vendor company which will be left outstanding, (*b*) as to £25,000 by the allotment of 100,000 5s. shares, and (*c*) as to £737,500 by the allotment of income bonds to that amount. A call of £2 10s. per share on the ordinary shares of the vendor company is estimated to produce £220,000, of which £220,000 is to be applied in reducing the outstanding amount of debenture stock of the said company from £470,000 to £250,000, as aforesaid. The board of the present company may not borrow on mortgages, debentures, debenture stock, or similar obligations beyond the £987,500 already provided for without the consent of a general meeting and the separate consent, by a three-quarter majority of votes, of the income bondholders. Voting powers: one vote for every four ordinary shares, and one vote for every £10 income bonds.

Hopper & Co., Ltd. (86,118).—This company was registered on October 12th, with a capital of £8,000 in £1 shares, to adopt an agreement with P. Hopper and H. Wilson, and to carry on the business of electricians, electrical and general engineers, ironmongers, builders of electric tramcars and other vehicles, manufacturers, importers and exporters of and dealers in dynamos, motors, telephones, bells, batteries and electrical apparatus, &c. The first subscribers (each with one share) are:—Mrs. G. du P. Hopper, 2, Hurst Road, Walthamstow; J. H. Fish, Cookley House, 39, Queen's Road, Walthamstow, traveller; Elsie A. E. Wooldridge, High Road, Loughton, Essex; H. C. Crosweller, 24, Arthur Road, Stoke Newington, N., electrical fitter; H. E. Crosweller, 24, Arthur Road, Stoke Newington, N., electrical fitter; H. Wilson, Orizaba, Forest View, Chingford, electrical appliance manufacturer; and P. Hopper, 2, Hurst Road, Walthamstow, electrical apparatus manufacturer. No initial public issue. The number of directors is not to be less than two nor more than five; the first are P. Hopper and H. Wilson; qualification, £100; remuneration as fixed by the company. Registered office, Elmsdale Works, Elmsdale Road, Walthamstow.

CITY NOTES.

The Edison & Swan United Electric Light Co.

The twenty-second ordinary general meeting of this company was held on Thursday of last week at Winchester House, Mr. Henry Wolfenden presiding.

The Chairman, in moving the adoption of the report, said at the last meeting he held out some hopes that on the present occasion he might have the pleasure of being able to recommend a dividend. He was very pleased to think that his anticipations had proved correct. It was quite true that the proposed dividend was a very small one, and a very inadequate return for the years of waiting which the shareholders had undergone, but they must regard it not so much for what it was, but rather as giving them a ground of hope for better things in the future. During the last year they had endeavoured to conduct the business of the company prudently and progressively, keeping ever in view the interests of their customers in the direction of a high standard of quality in their productions and reasonableness in their selling price. That their friends had recognised that was, he thought, shown in the continued and increased support which they had received. It was interesting to mention that early in the year there was an independent testing of all lamps of English makers and of several foreign makers made by an expert authority—the Westminster Electrical Testing Laboratory—and as a result, the Royal Ediswan came out first in quality of light and in efficiency, and it confirmed the absolute truth of their claim that their lamp was undoubtedly the best and cheapest in the end. He did not think any improvement which they had shown in their trading was due to the improvement in the trade of the country generally during the past year. He regarded that year as one of standing still. The new year since June 30th had shown distinct evidence of improvement in the trade of the country, in which he was glad to say they had shared, and continued to share. Of course, they still had keen competition to meet, and new discoveries in regard to lamps which were being made. He daresay most of them had been to the Exhibition at Olympia, and there they had seen that, notwithstanding the competition and new discoveries, they were quite able to compete in both directions. The net revenue showed that the sum of £47,898 had been brought forward from the profit and loss account, being an increase over the preceding year of £5,296. They had to provide for debenture interest £18,760, and they had allocated £12,000 as depreciation on freehold and leasehold property, plant and tools. That amount was in their opinion ample, and he trusted that at an early period they would see the propriety of reducing it. The stocks had been written down by £9,552, and the usual £1,000 had been added to the reserve for future stock depreciation, in addition to the £5,856 which was part of the profit on the purchase and cancellation of the debentures. Those latter sums were more by way of precaution than of actual depreciation, and he hoped that in the course of the next year or two, they would cease to make any provision under that head. The amount set aside for bad and doubtful debts, £2,667, was excessive, and was due to their fear that they might make a big debt in connection with the frauds that were being investigated at the Guildhall. They hoped, however, to recover a substantial part of that in consequence of the discovery of cash and valuables which had been made since the closing of their accounts. The net result was a balance of £11,907, to which must be added £5,302 brought forward from the previous year, making a total of £17,209. They recommended a dividend of 2½ per cent. on the "A" shares, which was 1s. 6d. on those shares of £3 paid, and 2s. 6d. on the fully paid-up shares. That would absorb £9,586, leaving £7,622 to be carried forward. They had purchased in the market and cancelled £43,947 of their debenture stock, which purchase had resulted in a profit of £6,907 as between the purchase price and the redemption figure at par. For some time to come they would discontinue the purchase of these debentures, and accumulate their reserves in a more liquid form. The Altrincham Co. continued to pursue a steady and progressive course. It had paid them a year's interest on its

debentures, and also £2,265 in reduction of their debt. He was not going to prophesy, but the indications were that the working results might leave a balance for dividend on the Altrincham Co. after meeting all prior charges and providing for reserve. That would, he believed, be the first time in the history of that company that such had been the case, and he saw no reason why, when once it had entered the ranks of the dividend-paying companies, it should not remain there.

Mr. E. B. Ellice Clark seconded the resolution.

Mr. Balfour, a shareholder, said that, in view of what the directors had done in bringing the company out of the throes of financial death, which it was in some years ago, he thought the shareholders ought to recognise their work in a substantial manner, and he moved that the sum of 750 guineas be voted to the directors, to be divided amongst themselves as they thought best.

Mr. Lea Smith seconded the motion.

Mr. Crisp, the solicitor, said that such a resolution could not be passed at that meeting, as it was necessary to give notice of such a motion.

The report was then adopted.

On the motion of the Chairman, seconded by Mr. E. B. Ellice Clark, the following resolution was carried:—

That the capital of the company be reduced from £941,090, divided into 150,000 "A" shares of £5 each, 26,436 "B" shares of £5 each, and 23,564 "B" shares of £2 10s. each, to £888,071, divided into 150,000 "A" shares of £5 each, 26,436 "B" shares of £5 each, and 23,564 "B" shares of 5s. each, and that such reduction be effected by cancelling paid-up capital which has been lost, or is unrepresented by available assets, to the extent of £2 5s. per share on each of the 23,564 "B" shares which have been issued and are now outstanding, and by reducing the nominal amount of each of such 23,564 "B" shares to 5s.

Mr. Balfour then put his resolution to the meeting for voting to the directors 750 guineas, and it was agreed to unanimously.

Mr. Crisp said that it would be necessary for it to be voted upon again by the shareholders at the meeting which would be held to confirm the resolution just passed for the reduction of the capital.

Norwich Electric Tramways Co.

The gross profit realised for the year ending June 30th was £10,006, increased to £10,838 by the balance brought forward from 1903-4, and amounts received for interest and transfer fees. Interest on debenture bonds absorbed £2,640, and £1,000 was placed to the reserve fund, which now stands at £4,197, leaving £7,198 to be dealt with. The directors recommend a dividend of 2½ per cent. for 1904-5, absorbing £6,600, a balance of £598 being carried forward. The revenue for the past year showed a decrease of £81, while the working expenses were £681 more, in consequence of exceptional outlay made for maintenance and repairs, including the renewal of several important junctions. The number of passengers carried during the past year were 7,409,126, and 1,083,055 car-miles were run.

Swansea Improvements and Tramways Co.

The half-yearly report to June 30th last shows gross receipts amounting to £16,751, an increase of £2,920. Expenses amounted to £12,542, an increase of £2,557. The net profit on the half-year was £4,293, and after meeting the preference dividends this, with £1,987 brought forward, allows of a balance of £3,986 to be carried forward and £1,000 to be placed to reserve account. A deficiency of £3,052 is shown for the half-year on the working of the Mumbles Railway and Pier section, and on this part of the undertaking the total sum provided to date by the B.E.T. Co. for capital expenditure, working deficiencies, and for the first quarter's rent of lines, amounts to £43,014.

British Columbia Electric Railway Co.

The ninth ordinary general meeting of this company was held at Liverpool Street Hotel, E.C., on Monday, Mr. R. M. Horne Payne presiding.

The Chairman, in moving the adoption of the report, said that he had very little to say to the shareholders. The company was now a very strong and well-established undertaking, and had become like the typical alderman "sleek, fat, stodgy and uninteresting." The principal and important events during the year had been the complete reorganisation of their administrative arrangements; the completion of the Vancouver power plant, and the opening of the electrified railway to Stevenson; the agreement with the Canadian Pacific Railway which they sanctioned at the last meeting; the acquisition and opening of a new pleasure park at Victoria, and the signature to a contract with the Corporation of North Vancouver to extend their operations in that young city. The installation in connection with the Vancouver power plant had been completed and opened. The gigantic work was carried through without a hitch. The work in connection with the electrifying of the railroad to Stevenson was accomplished by their own staff in record time, and the line was opened for traffic on July 4th. It was still too soon to say definitely what the effects of that and of the power installation were going to be upon the profits of the company. They were still going through a period of experiment, and the monthly traffics would tell the shareholders as much as the directors knew themselves. He thought it fair, however, to anticipate that, as a result of the agreement with the Canadian Pacific Railway, there would be a nice little revenue to be divided between them annually. The new park at Victoria was not undertaken as a source of profit, but merely in accordance with their policy of helping the cities in which they worked. The park had given much satisfaction to the inhabitants of the city, and so had the railway, light and power business in North Vancouver. Although it could not be a source of profit for some years to come, they were much gratified at having established themselves in that very progressive city, which had an absolutely sure future before it.

Mr. E. L. Evan Thomas seconded the motion, and the report was adopted.

The Indian Electric Supply and Traction Co.

The first ordinary general meeting of this company was held at Winchester House, E.C., on Thursday last week, Sir Walter Laurence presiding.

The Chairman said that the meeting was called under the Companies' Act. The company was the pioneer in supplying electric power in India, and he was glad to say that they were proceeding satisfactorily. The first shipment of cables had been made, and the contractors hoped by next March that they would be able to supply current for lighting and fans. The work at the power house was well in hand, and wiring contractors had received orders. Canvassing in Cawnpore indicated that there would be eager applicants for power as soon as it was available. Inquiries had been made as to the extension of the tramway in any district where there would be profitable traffic, but in the meantime the energies of the company would be directed to completing the lines laid down in the specification in the prospectus, and they hoped they would be opened for traffic before the specified time, November 30th, 1906. There had been a welcome reduction in the railway rates for coal of about 1s. 9d. per ton, and that would enable them to bring coal to Cawnpore under 13s. per ton. The work in Cawnpore had proceeded smoothly, and the company had met with co-operation and assistance and consideration at the hands of the local authorities. The objects of the company were not confined to Cawnpore, and they contemplated the time, as the company went on, when they would bring an electric supply to other large towns in India. Application had been made to the Stock Exchange for an official quotation for the debenture stock, and the necessary formalities were being complied with. Some little difficulty had been experienced in consequence of the stock not having been fully paid up, but that had now been surmounted. The position at the present moment was that, of the £125,000 of stock issued, £100,040 had been paid up, and the remaining £24,960 would fall due for payment on December 31st. The chairman, in conclusion, mentioned that he would be visiting India this winter.

Auditors were appointed, and at the conclusion of the meeting another meeting was held, at which the appointment of Mr. W. B. M. Bird as a trustee of the trust deed was agreed to.

The Cuba Submarine Telegraph Co.

The sixty-eighth ordinary general meeting of this company was held at the company's offices, 58, Old Broad Street, on Wednesday, Mr. Charles W. Parish in the chair.

In moving the adoption of the report and accounts, which were taken as read, the Chairman remarked that the report dealt with six months' working of a very ordinary character. The last time he addressed the shareholders, he had to tell them that they had been working under some difficulties, with two cables down; but he was also able to report that their main cable from Cienfuegos to Santiago had been laid, and that the Manzanillo-Santiago cable had also been laid. Those cables were completed last January or February, and since then the business had been very satisfactory. Compared with the corresponding half-year of 1904, the receipts might seem small. In 1904 the receipts were £16,526, while this year they were only £14,811. He would like to explain that difference by saying that in 1904 the French cable was down for part of the time—3½ months out of the six, in fact—and that had brought them an increase in traffic which they would not otherwise have got. The Island of Cuba had prospered, certainly more than the West Indies, and the company had done fairly well. The cable receipts, as he had said, had been £14,811, and to that sum they had to add the interest from investments—£1,450—which, with the transfer fees, brought the total receipts up to £16,272 16s. 9d. Expenses amounted to £6,334, so that they had a balance of £9,338, to which had to be added the balance of £3,093 from the last account. The dividend on the preference shares would absorb £3,000, leaving £10,031, out of which they proposed to pay a dividend of 5 per cent. on the ordinary shares, and carry forward the balance—£6,031—to the current half-year. The appeal of the company to the Law Courts of Cuba for the subsidy due to them, had not come up for judgement. During the past three months, he was glad to say, the company had been holding its own.

Replying to a shareholder, Mr. Parish said that all the cables were in use.

Mr. Geo. Keith seconded the motion, and the report was adopted.

Consolidated Electrical Co.

The directors of this company announce that the negotiations referred to by the chairman at the last ordinary general meeting of the company for the sale of the works at Canonbury, and of the manufacturing works carried on thereat, have been brought to a successful issue. A new company entitled "The Consolidated Supply Company, Limited," has been registered for the purpose of acquiring and extending such works and business. The sale takes effect as from March 31st. The

registration of the new company was notified in our issue of September 29th. To the business carried on by the Consolidated Electrical Co., the Supply Co. is adding the business of manufacturing and supplying railway and tramway accessories, for which the works are admirably adapted, and for which there is a comparatively new and profitable field of enterprise. The *Financial Times* says that, in order that the shareholders may have an opportunity of directly interesting themselves in the Supply Co., the directors have, under the terms of the agreement, secured to the shareholders the right to subscribe for 6 per cent. preference shares in the Supply Co., to a total amount not exceeding £5,000. The registered address of the company has been changed to Broad Street House, E.C.

The directors have informed the shareholders that in consequence of the great improvement recently effected in the financial position of the company, and the reasonable assurance of a net profit for the current year more than sufficient to meet the preference dividend now in arrear, as well as that now accruing, they feel justified in paying off the whole of these arrears, covering the period of 18 months from November 30th, 1903, to May 31st, 1905.

Callender's Cable and Construction Co. — The directors have decided to pay an interim dividend on the ordinary shares on November 1st next of 5s. per share, being at the rate of 10 per cent. per annum. The books will be closed from the 18th to to the 31st, both days inclusive, for the purpose of preparing this dividend.

Stock Exchange Notice. — Application has been made to the Committee to allow the following to be quoted in the Official List:—

Lisbon Electric Tramways, Ltd.—500,000 ordinary shares of £1 each fully paid, Nos. 1 to 500,000; 425,553 6 per cent. cumulative preference shares of £1 each fully paid, Nos. 1 to 425,553; and £500,000 5 per cent. mortgage debentures of £100 each, Nos. 1 to 5,000 (Registered). (Renewed Special Application.)

Monte Video Telephone Co.—The directors' report for the year ending July 31st last, showing a net profit for that period of £15,473 after providing for all working expenses in Monte Video and London. To this amount should be added the sum of £1,806 brought forward from last year, leaving an available balance of £17,279. After transferring £5,000 to reserve fund, and £3,000 to reserve for renewal of plant, the directors recommend payment of the full dividend at the rate of 5 per cent. per annum upon the preference share capital, and of a dividend at the rate of 4 per cent. per annum upon the ordinary share capital, leaving a balance of £2,047 to be carried forward. There has been a marked increase in the number of subscribers, and a proportionate increase in the receipts for the year.

Oriental Telephone and Electric Co. — The directors have declared the following interim dividends:—3 per cent. on the 6 per cent. cumulative preference shares for the current year, less income-tax; and 3 per cent. on the ordinary shares, free of income-tax. The warrants will be posted on 31st inst. The share transfer books will be closed from the 19th to the 31st inst., both days inclusive.

Metallic Seamless Tube Co.—The directors, after providing for depreciation, recommend a dividend of 5 per cent. on the ordinary shares for the year ended June 30th last, leaving £1,010 to carry forward.

Globe Telegraph and Trust Co.—The directors announce a quarterly interim dividend of 2s. each on the ordinary shares.

Western Telegraph Co.—The directors, after transferring £60,000 to the general reserve fund, and £5,000 to the maintenance ship's reserve fund, have decided to recommend a final dividend of 3s. per share, making, with previous distributions, a total dividend of 6 per cent. for the year ended June 30th, 1905, and also the payment of a bonus of 2s. per share, both free of income-tax. The balance of the account is carried forward. The register of transfers will be closed from October 24th to November 1st.

Western Union Telegraph Co.—The net revenue of this company for the quarter ended June 30th last equalled $1,701,006, and the surplus at the same date $15,974,209, which, after estimating traffic to December 30th, and paying dividend, now stands at $16,325,888.

STOCKS AND SHARES.

Wednesday evening.

Unless the Bank Rate rises to 5 per cent., Stock Exchange markets are bound to be unsettled, at any rate up to the end of the year. The fulfilment of everyone's fears might lead to a general hardening of prices, for suspense is worse than a 5 per cent. Bank Rate known to be but temporary. Electrical sections, however, continue the even tenour of their way, scarcely influenced by the money market. In fact, an important new electrical undertaking will be presented to the public within the next 10 days or so. The Olympia Exhibition has certainly done no harm to the quotations of shares, whatever ill effects it may have had upon the digestions of the entertaining and entertained exhibitors and others. Rather has the show directed more public attention to the shares of an industry able to produce such an excellent advertisement for its wares.

Except for a two-point fall in Waterloo and City stock, the Railway market shows no alteration. The reason for the drop is merely that there are so many other stocks of good character yielding better rates. Metropolitan Consolidated is 89, and District Ordinary 34⅜, a point better on the traffics. Baker Street and Waterloo Debenture is slightly lower at 101, a quotation that does not look extravagant, although, of course, the security carries considerably more risk than the usual Railway Debenture stock.

Shareholders in the Calcutta Electric Supply Co. receive a substantial bonus in getting their proportion, 4 in 1, of the 20,000 new shares at £6 10s. per share. The existing issue stands at 9 *ex* rights, and dealings in the new have taken place on the basis of 1⅜-1⅝ premium.

Charing Cross Ordinary shares improved ⅝, and City of London Electric Ordinary ¼, upon the general public acquaintance with the working agreement between the two companies to which we alluded a fortnight ago. It is thought in some quarters that the two companies may take steps to obtain a higher price from their customers. Both concerns, freed from internecine strife, should now be able to develop their splendid businesses in a manner that shall give shareholders every cause for satisfaction with the present prudent policy of the Boards.

By a rise of a sovereign, County of London Ordinary are lifted to 10¼, and the Preference are ⅝ up at 12⅜. The view is expressed that County shares have been unduly low for some time past. London Electric Preference improved 5s. to 5⅜, and St. James' a similar sum, to 14⅜: the comparative dullness recently of these last has been difficult to account for. South London Ordinary rose ⅛ to 3⅞, and Brompton Preference fell to the same extent. All the Debenture stocks in this market are wanted.

Amongst Traction descriptions, British Electric Ordinary and Preference have both advanced ⅜, and it is said that the company is doing considerably better than was the case some months back. The Swansea Tramways Co., a baby of the British Electric Traction, announces an increase in its half-yearly gross receipts of £2,920, but also an increase of £2,557 in the expenses. The Preference interest will be paid. Anglo-Argentine Ordinary are a trifle up at 8 7/16, and Belgrano shaded to 3⅛. Another small drop in Cape Electrics, to 25s., is again traceable to the proposal to create further borrowing powers. Calcutta Trams are being bought at 8 7/16, possibly on the approaching Royal visit to India. London Motor Omnibus shares have shot up to 1⅛ middle.

Several French traction and tramway shares have lately come into favour on the Paris Bourse, causing a rise over here in the shares of the Exploration Assets Co. This affair arose out of the old Exploration Co., to whose shares the Stock Exchange gave the nickname "Rothschilds"; upon its reorganisation the Assets Co. was formed to deal with the various French traction interests of the old undertaking, and the price of the Assets shares is now 4s. 9d. to 5s. 3d., with a good deal of business being done in them.

Telegraph stocks are mostly remarkable for the various dividends deducted on October 13th. Some of the amounts were promptly recovered, such as the 2s. 6d. on Eastern Extension shares. Others have been partially recovered, as in the cases of Anglo-American Preferred and Eastern Telegraph Ordinary stocks. Direct United States Cable are noticeably strong at 12⅞. Reuter's shares are lowered ¼ to 8, *ex* the 4s. dividend. Except for these, the changes on the week do not amount to much. Indo-Europeans are again better at 55½, and Anglo "A" has shed ¼ to 16⅜. It may be observed that the Anglo-American Telegraph dividends will be paid on November 1st, which is All Saints' Day, and (though not therefore) a Stock Exchange holiday. The Globe Telegraph and Trust declares its usual quarterly dividends at 2s. on the Ordinary, and 3s. on the Preference shares, the quotations have not changed.

Manufacturing companies ought to derive most direct benefit from Olympian stands, and it is fitting that Edison & Swan should be some 6s. 6d. better, allowing for the dividend. The Preference are also *ex*, but no alteration has been made in the excessively wide official price. Rubber shares have not moved, despite the keen interest now being taken in the commodity. Bruce Peebles Preference shares are 5, Babcock & Wilcox Ordinary 37s. 8d., and the Preference 30s. Vickers seem unable to get away from 55s., their present fairly high price, but they are talked better.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years.				Closing Quotations Oct. 11th.	Closing Quotations Oct. 18th.	Business done week ended Oct. 18th, 1905.		Rise + or Fall −
			1902.	1903.	1904.	1905.§			Highest	Lowest.	
£											
34,800	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	..	99 —102	99—102	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3⅛	3 - 3⅛	3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	..	82 — 87	82 — 87	..	..	..
768,580	Anglo-American Telegraph	Stock	60/6	61s.	22½%	29s.§	61 — 63	60 — 62 xd	..	..	..
3,118,210	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5¼%	5¾.§	109 —110	108—109xd	109⅜	108	..
3,118,210	Do. do. do. Deferred	Stock	1/-	2s.	Nil	..	16⅜— 16⅝	16⅜— 16⅝	16⅛	16⅛	— ⅛
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	7⅜— 7⅝	7⅜— 7⅝	7⅝	7⅜	..
1,992,856£	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	..	97 — 90 xd	97 — 99	98½	97½	..
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	5 %§	9 — 9¼	9 — 9¼	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %§	17⅜ — 18½	17⅜ — 18½	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %§	3⅜— 3⅝ xd	3⅜— 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %§	9¼— 9½ xd	9¼— 9½	9⅜	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%§	100 —103 %	100 —103	..	..	..
60,710£	Direct United States Cable	20	8½%	8 %	8½%	8 %§	12 — 12⅛	12⅛— 12⅜xd	12⅜	11⅞§	..
74,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	..	100 —102	100 —102	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	5 %§	143 —146	142 —145 xd	144½	142⅜	..
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%§	90 — 92	89 — 91 xd	90	89	..
1,836,814	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %§	108 —110	108 —110	..	..	..
800,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	6 %§	13⅜— 14⅛	13⅜— 14⅛xd	14⅛	13⅞	..
602,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %§	106 —108	106 —108	107½	..	..
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	..	99¾—101⅛	99¾—101⅛	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	..	101⅛—103⅛%	101⅛—103⅛	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅝%	..	10⅜— 11	10⅜— 11	10⅝	10⅜	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	14⅜— 14⅝	14⅜— 14⅝	14⅞	14⅛	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	..	35½— 36½	35½— 36½	..	..	..
46,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	..	100 —102	100 —102	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	18 %	..	54 — 56	54½— 56½	56½	54½	+1
72,680	Monte Video Telephone Co., Ltd. Ord. ..	1	3	3	..	..	2— ⅜	2— ⅜	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %§	112 —113	112 —113	113	112⅜	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %§	107 —109	107 — 108	108	107	— ⅛
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %§	13⅜ — 14½	13 — 15	14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %§	12 — 13	12 — 13	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %§	5⅜— 5⅞	5⅜— 5⅞	5⅝§	5⅛§	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	..	99 —101	98 —100	98¼	..	-1
1,689,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	..	104½—106½	104 —106	105⅛	..	— ⅛
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6¼%	6¼%	..	1⅜— 1⅝	1⅜— 1⅝	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1 1/16— 1 1/16	1 1/16— 1 1/16	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	..	100 —103	100 —103	..	..	..
11,889£	Reuter's	8	5 %	5 %	5 %	5 %§	8 — 8½	7⅞— 8⅛xd	7⅞	..	..
3,237	Submarine Cables Trust	Cert.	6 %	6 %	6 %	..	127 —130	125—128 xd	..	..	..
58,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7 — 7⅛	7 — 7⅛	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	5⅛— 5⅜	5⅛— 5⅜	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	..	110 —112	110 —112	..	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	..	10 — 10⅛	10 — 10⅛	10⅛	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	⅜— ½	⅜— ½	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	..	100 —102	100 —102	..	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	..	14 — 14½	14 — 14½	..	..	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	..	101 —103	101 —103	..	..	..
568,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	..	102½—104½	102½—104½	..	..	..
98,221	West India and Panama Telegraph	10	Nil	Nil	Nil	..	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	..	8½— 9	8½— 9	..	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	7⅞— 8⅛	7⅞— 8⅛	7⅞	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	..	101 —104	101 —104	102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

40,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	..	5 — 5⅛	5 — 5⅛	..	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	..	4⅜— 5⅛	4⅜— 5⅛	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	..	2⅜— 3⅛	2⅜— 3⅛	..	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	99 —103	100—104	..	..	+1
183,801	British Electric Traction	10	8 %	6 %	6 %	..	9 — 9⅛	9⅛— 10	9⅜	9 7/16	+ ⅛
156,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	10⅜— 11⅛	11— 11⅛	11 1/16	..	+ ⅛
1,000,000£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	121 —123 xd	121 —123	122⅛	122	..
250,000	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	..	99 —101	99 —101	100	99⅜	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %§	6⅞— 7	6⅞— 7	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %§	6⅜— 6⅞	6⅜— 6⅞	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%§	103 —106	103 —106	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅞— 1 1/16	⅞— 1 1/16	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	Nil	Nil	Nil	..	⅜— ⅝	⅜— ⅝	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	..	1⅛— 1⅜	1⅛— 1⅜	1 1/16	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	..	93 — 97	93 — 97	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	..	78 — 81	78 — 81	..	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	..	10⅜— 11⅛	10⅜— 11⅛	11⅛	10⅜	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5⅜— 5⅝	5⅜— 5⅝	..	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	..	109 —111	109 —111	..	..	..
963,208	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %§	91 — 93	91 — 93	91⅞	..	..
523,396	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %§	101 —103	101 —103	..	..	..
523,396	Do. do. Def. do.	Stock	4 %	4 %	4 %	..	83 — 86	83 — 86	..	..	..
* 1,330,000	City and South London Railway	Stock	3½%	2½%	2½%	2 %§	40 — 42	40 — 42	41	40	..
85,000	Crompton & Co., Nos. 1 to 85,000	5	5 %	2½%	2½%	..	1⅜— 1⅝	1⅜— 1⅝	..	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	..	95 —100	95 —100 %	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½%§	..	1⅛— 1⅜	1⅛— 1⅜ xd	1⅛	1 1/16	..
17,139	Do. "A" shares, 01—017,139 ..	5	Nil	Nil	2½%§	..	2 — 2⅛	2 — 2⅛ xd	..	..	..
944,023£	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	85 — 90	85 — 90	..	..	..
100,000£	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	..	90 — 95	92 — 97	..	..	+2
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	⅜— ½	⅜— ½	..	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	1⅛— 2⅜	1⅛— 2⅜	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Sk.	Stock	4 %	4 %	4 %	..	92 — 95	92 — 95	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref. ..	10	5 %	5 %	5 %	..	9½— 10	9½— 10	..	..	..
200,000	Do. do. 4 % Mort. Deb. ..	Stock	4 %	4 %	4 %	..	97 —101	96 —100	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord. ..	5	20 %	15 %	15 %	10%§	12 — 13	12 — 13	12⅜	12⅛	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	..	5⅛— 5⅜	5⅛— 5⅜	..	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	..	109 —111	109 —111	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10 %	10 %	5 %	2½%§	15⅜— 16⅛	15⅜— 16⅛	..	..	..
800,000£	Do. do. 4% 1st Mort. Deb. ..	100	4 %	4 %	4 %	..	99 —102	99 —102	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	1½%	..	2⅛— 2⅜	2⅛— 2⅜	..	..	— ⅛
10,000	† Do. do. Pref. £10 paid ..	10	5 %	5 %	5 %	5 %	9 — 9½	9 — 9½	..	..	..
87,350	Telegraph Construction and Maintenance ..	12	20 %	20 %	15 %	..	34 — 36	33½— 35½	34½	34⅛	— ⅛
150,000£	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	..	102 —104	102 —104	..	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3 %§	90 — 92	88 — 90	..	..	—2

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
¶ From Manchester Share List.

Bank rate of discount 4 per cent. (September 28th, 1905).

SHARE LIST OF ELECTRICAL COMPANIES *(continued)*.—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	§1905.	Closing Quotations Oct. 11th.	Closing Quotations Oct. 18th.	Business done week ended Oct. 18th, 1905. Highest	Lowest.	Rise + or Fall—
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	† 5	8 %	10 %	10 %	..	9⅜ — 10½	9⅜ — 10½	..	..	..
29,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	9⅜ — 10¼	9⅜ — 10	9⅜	..	— ⅛
10 782	Central Electric Supply 4 % Guar. Deb. Stock ..	100	4 %	4 %	4 %	..	101 —107	105 —108	105½	..	+1
80,000	Charing Cross and Strand Electricity Supply ..	5	10 %	8 %	8 %	5 %§	7¼ — 7⅝	7⅞ — 8⅛	8 1/16	7⅞	+ ⅛
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½ %	4½ %	4½ %	..	5⅜ — 5⅝	5⅜ — 5⅝	..	..	+
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½ %	4½ %	4½ %	..	4⅜ — 5	4⅜ — 5	..	..	..
40,000	Do. do. 1903	5	..	4½ %	4½ %	..	4⅞ — 5⅛	4⅝ — 5⅛	4 31/32	..	..
350,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	..	103 —105	103 —105	..	..	..
44,426	Chelsea Electricity Supply, Ord.	5	4½ %	5½ %	6 %	4½ %§	5⅝ — 6⅛	5⅝ — 6⅛	6 1/16	..	..
150,000£	Do. do. 4½ % Deb. Stock Red. ..	Stock	4½ %	4½ %	4½ %	4½ %§	109 —111	109 —111	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	..	12 — 13	12½ — 13½	13 1/16	12½	+ ½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	..	13½ — 14½	13½ — 14½	..	..	..
400,000£	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	..	124 —128	124 —128	126	..	..
300,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½ %	4½ %	4½ %	..	104 —106	104 —106	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½ %	4 %§	9 — 9¼	10 — 10½	10½	9¼	+1
30,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	..	12 — 12½	12⅝ — 12⅞	12⅝	..	+ ⅜
400,000£	Do. do. 4½ % Deb. Stock ..	..	4½ %	4½ %	4½ %	..	111 —114	111 —114	113⅝	113	..
250,000	Do. do. 4½ % 2nd Deb. Stock ..	Stock	4½ %	4½ %	4½ %	..	103 —105	104 —106	..	..	+1
70,000	Edmundson's Electric Corporation, Ord. Shares ..	5	7 %	7 %	7 %	..	5⅜ — 6½	5⅜ — 6½	6	5 3/16	..
80,000	Do. do. 6 % Cum. Pref... ..	..	6 %	6 %	6 %	..	6⅜ — 6⅝	6⅜ — 6⅝	..	..	..
800,000£	Do. do. 4½ % 1st Mort Deb. Stk	100	4½ %	4½ %	4½ %	..	108 —110	108 —110	..	..	..
21,000	Kensington and Knightsbridge Electric Ord. ..	5	10 %	12 %	12 %	..	12 — 12⅞	12 — 12⅞	..	..	..
136,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	..	97 —100	97 —100	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	..	2 — 2⅛	2 — 2⅛	2⅛	..	..
60,000	Do. do. do. 6 % Pref...	5	6 %	6 %	6 %	..	4⅞ — 5⅛	5⅛ — 5⅜	5⅛	..	+ ⅛
371,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	..	99 —102	99 —102	..	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	5	7½ %	8¾ %	10 %	10%§	10½ — 10⅝	10 — 10½	10⅜	10⅜	— ½
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½ %	4½ %	4½ %	..	5⅝ — 5⅞	5⅝ — 5⅞	..	..	..
220,000£	Do. 4½ % 1st Mort. Deben. Stock ..	..	4½ %	4½ %	4½ %	..	109 —113	109 —113	109	..	..
250,000£	Do. 3½ % Mort. Deben. Stock Redeem.	Stock	3½ %	3½ %	3½ %	..	98 —100	98 —100	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½ %	4½ %	4½ %	..	101 —103	102 —104	..	..	+1
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	..	14 — 15	14 — 15	14⅞	14⅜	..
59,000	Do. do. 4 % 1st Mort. Deb... ..	100	4 %	4 %	4 %	..	98 —100 xd	98 —100	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord. ..	5	14½ %	14½ %	14½ %	10%§	14 — 15	14½ — 15½	..	..	+ ½
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %§	8 — 9	8 — 9	..	..	..
150,000£	Do. do. 3½ % Deb. Stock Red. ..	100	3½ %	3½ %	3½ %	..	98 —100	99 —101	..	..	+1
12,000	Smithfield Markets Electric Supply, Ord.	5	2½ %	4 %	4 %	..	2¼ — 2⅜	2 — 2¼	2 3/32	..	— ⅛
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	1½ %	3 %	4 %	..	3¾ — 4	3⅞ — 4⅛	..	..	+ ⅛
100,000	South Met. Elec. Lt. & Power (Ord..	1	Nil	Nil	Nil	..	1/8 — 1/4	1/16 — 1/8	..	..	..
50,000	*(Late Blackheath and Greenwich* 7 % Pref... ..	1	Nil	7 %	7 %	..	1/16 — 1/8	1/16 — 1/8	..	..	..
100,000	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½ %	4½ %	4½ %	..	105 —108 xd	105 —108	..	..	..
30,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	4⅜ — 4⅝ xd	4⅜ — 4⅝	4⅜	..	..
30,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5 — 5⅛ xd	5 — 5⅛	..	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½ %	..	103 —105 xd	103 —105	..	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½ %	14 %	13%§	12⅝ — 13⅜	12⅝ — 13⅜	13⅛	13 1/16	..
28,151	Do. do. 5 % Cum. Pref. ..	5	5 %	5 %	5 %	..	6⅜ — 6⅝	6⅜ — 6⅝	6⅜	..	..

Shares not officially quoted :—Mackay Companies, ord., 46¾—47¼. Pref. 75½—76.

† Unless otherwise stated all shares are fully paid. § Interim dividends.

MARKET QUOTATIONS, Wednesday, October 18th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	32/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£5 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£18	..
a	Benzole (90 %)	per gal.	10d.	..
a	,, (50 %)	per gal.	9½d.	..
a	Copper Sulphate	per ton	£20	..
a	Lead, Nitrate	per ton	£25	..
a	,, White Sugar..	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a	Potassium Bichromate, in casks	per lb.	3d.	..
a	Potash, Caustic (75/80 %) ..	per ton	£30	..
a	Potassium Cyanide	per lb.	7½d.	..
a	Shellac	per cwt.	190/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£3	..
a	Sodium Bichromate, casks ..	per lb.	2½d.	..
a	,, Cyanide	per lb.	7d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£150	..
b	,, Wire, in ton lots ..	per ton	£177	..
b	,, Sheet, in ton lots ..	per ton	£175	..
b	Babbitt's metal ingots	per ton	£43 to £140	..
c	Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	..
c	,, Tube (brazed)	per lb.	9¾d.	..
c	,, ,, (solid drawn).. ..	per lb.	8¼d.	..
c	,, Wire, basis	per lb.	8d.	..
c	Copper Tubes (brazed)	per lb.	10¾d.	..
c	,, ,, (solid drawn) ..	per lb.	11d.	..
g	Copper Bars (best selected) ..	per ton	£85	£1 inc.

	METALS, &c. *(continued)*.		Latest Price.	Fortnight's Dec. or Inc.
g	Copper Sheet	per ton	£85	£1 inc.
g	,, Rod	per ton	£85	£1 inc.
e	,, (Electrolytic) Bars ..	per ton	£77 10	..
e	,, ,, Sheets ..	per ton	£90 10	..
e	,, ,, Rod ..	per ton	£84 10	..
e	,, ,, H.C. Wire	per lb.	9¾d.	..
f	Ebonite Rod	per lb.	3/3	..
f	,, Sheet	per lb.	3/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha, fine	per lb.	6/- to 7/-	..
h	India-rubber, Para fine	per lb.	5/3 to 5/4	dec.
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	54/1½	2s. 7½d. inc
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£15 5	7s. 6d. inc.
g	,, Sheet	per ton	£16 17 6	7s. 6d. inc.
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£7 5	2s. 6d. inc.
d	Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d	,, ,, ,, medium	per lb.	2/6 to 4/-	..
d	,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/1 to 1/3	..
p	,, rolled bars & rods	per lb.	1/1½ to 1/3	..
p	,, ,, strip & sheet	per lb.	1/4	..
o	Platinum	per oz.	84/-	..
e	Silicium Bronze Wire	per lb.	10½d. to 11½d.	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£150 to £151	30s. inc
n	,, Wire, Nos. 1 to 16	per lb.	1/9½	..
p	White Anti-friction Metals— "White Ant" brand.. ..	per ton	£46 to £70	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	,, 6 lea. Flax	per lb.	5¾d.	..
j	,, 3 ply 10 lbs. Russian ..	per lb.	4 11/16d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£31 15	10s. inc.

Quotations supplied by Messrs. :—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons, Ltd.; *d* F. Wiggins & Sons; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

The Longsdorf Furnace. — The smoke-preventing furnace is one of the numerous adaptations of the steam jet. Steam is admitted to a perforated pipe through a superheating saddle placed around the firedoor and over the front part of the fire. This saddle is made of cast-iron or steel, ribbed internally to secure a long passage for the steam and exposure to the heated metal. These steam jet appliances are especially useful where the draught is insufficient to draw in over the fire the secondary air for the combustion of the hydro-carbon gases, and the superheating of the steam jet is, of course, beneficial, the use of wet steam being undesirable. The apparatus is particularly applicable to internally fired boilers which have correctly arranged furnaces, and are smoky or clean according to circumstances. The steam jet, properly worked and, perhaps, combined on occasion with the ashpit dampers, is often able to effect just that last aid to smokeless combustion which cannot be got without the steam-assisted air indraught. Experience has shown that the steam thus blown into a furnace is best directed over the area of the fire from about one-third of its length up to the bridge. In the Longsdorf furnace the perforated pipe is placed above the superheating saddle, and transversely to the flue, the perforations for steam being on its front side. The Longsdorf furnace is in the hands of Messrs. F. Jordan and Co., of 15, George Street, E.C.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

(*Continued from page* 611.)

The Vulcan Swivel Siphon and Pressure Gauge.

This is a new design of siphon and steam pressure gauge which is being made by Messrs. J. Hopkinson & Co., Ltd., of Huddersfield. It is adapted for cylindrical water-tube boilers, and other positions where the pressure gauge is fixed a considerable height above the firing floor level. It is a novel combination designed to secure a firm support for the steam gauge, quite independent of the siphon. The latter is in the form of a copper coil with ample cooling surface, which can be easily detached and blown through without disturbing, or in any way interfering with, the gauge, which is a great advantage. This easy detachment of the coil forming the siphon is one of the special features of the arrangement, as it permits of the gauge being tested by a separate pump without dismounting the gauge. The operation of uncoupling the siphon coil, testing the gauge to the full extent of its range, and recoupling ready for work, occupies at the most, not more than a few minutes.

As the support for the gauge is independent of the coil, the weight of the gauge is immaterial, and advantage is taken of this to use a sector-shaped gauge whose working parts are more mechanical than those in the circular gauge. The combination of gauge and siphon coil can be swung round to any angle, which makes it possible to read a number of gauges simultaneously from one position. The swivel arm attached to the back of the gauge is effectively insulated by a washer of special material, with the result that the gauge and its tube are kept cooler. The combination of gauge, siphon, and electric lamp makes a handsome fitting.

The figures are marked on a white opal dial, and, to make the reading at the working pressure more distinct, each increment up to the working pressure is marked, but beyond, the dial is graduated for testing purposes only, in readings of, say, 40 lb. As the dial is not opaque, it can be illuminated from behind, and the position of the finger can, therefore, be readily distinguished at night, or when the gauge is fixed in a dark place.

The back of each gauge is provided with a facing arranged to carry a bracket and incandescent lamp.

The whole is enclosed in an electro-plated dust-proof case; the mechanism of the gauge, however, is visible to the engineer and is protected by strong glass inserted in front of the case. An important claim is that the arrangement can be efficiently tested, so as to comply with the requirement of the Factory Act of 1901.

Fig. 78 shows a view of the gauge and siphon in working position. Fig. 79 shows a side elevation, the back of the gauge being provided with a fixing and incandescent lamp for illuminating the dial. The front of the gauge is shown slightly canted so as to be more easily seen from the firing floor level. Fig. 80 gives a rear view, illustrating how the gauge can be swivelled; by this means the gauges of a range of boilers can be set so as to be all seen from one position. Fig. 81 illustrates the arrangement with the siphon coil disconnected and the tester attached. The siphon can in this position be blown through without affecting the gauge.

A fully illustrated pamphlet relating to this apparatus has been published by Messrs. Hopkinson, and therein fuller particulars will be found, together with dimensional drawings and prices. The same publication contains a full account of the Vulcan portable gauge tester, the method of its application, and its advantages.

Fig. 78.

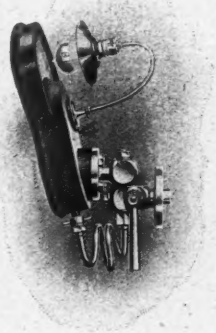


Fig. 79.

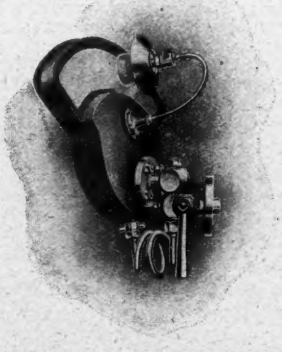


Fig. 80.

Fig. 81.

Electric Light Raising and Lowering Fittings.

There can be no doubt that among the many benefits derived from the use of the electric light, one of the most important is the facility for handling the light and altering its position to suit varying requirements. The "acme" of utility in this direction is, of course, found in the portable hand lamp fitting, but next to this and possessing features of utility entirely its own, is the pendant with a raising and lowering arrangement. Alterations in the condition of the supply of electric current have necessitated considerable alterations in the details of the insulating covering, and the flexible which was found thoroughly suitable for 60, 80 or 100-volt practice is a very different article from that now required for 200-250-volt circuits. The thickness of the india-rubber covering in particular has been greatly increased, and the rubber is now vulcanized to meet the increased risk from electric faults inseparable from higher voltage practice. Some of the consequences of these changes are stated to be:—The necessity for very heavy balance weights to counteract extra friction; the liability of the rubber to "set" over the wheels and refuse to "flex" if the fitting be not constantly in use; the risk of electric faults resulting from the cracks which occur after a time in even the best of vulcanised rubber. It is considered that the raising and lowering pendant has

Fig. 82.

now become indispensable, and the Holland House Electrical Co., of 9, Holland Place, Glasgow, have experimented with various forms of suspension for overcoming the difficulties and thus removing from the use of this form of fitting, the risks with which it has hitherto been attended. The accompanying illustration (fig. 82, p. 649) shows the adaptability of the company's "Makwat" patent attachment to meet all the requisites of electric light raising and lowering fittings. The chief advantages claimed are as follows:—The fitting and the balance weights are suspended by metal chains; the conductor simply carries the electric current; there is no risk of the fitting or balance weights falling through the flexible breaking or being burnt through; any thickness of flexible can be used, as hardening of the rubber insulation does not interfere with the free motion of the fitting; these fittings will work with perfect freedom even after having been out of use for an indefinite period; the suspending chain being more pliable than the flexible, and passing over only half the number of pulleys required in all other types, the weight of the counterbalance is consequently reduced by one-half.

The method by which the electric conductor is attached to the cord or chain which suspends the fitting reduces the amount of "slack" in the conductor to a minimum, and experience has shown that in the majority of cases this "slack" is not at all an eyesore, while it ensures immunity from all risk, either from fire or from the counterbalance falling.

"Konnectic" Connectors.

We illustrate herewith a connector for high tension connections to sparking plugs. It was first introduced to the public at the Motor Exhibition at the Royal Agricultural Hall in March last, when a large number were sold, and since then there has been a steadily increasing demand for it.

We understand that it can be used for any connection—accumulator cells, magneto-coils, sparking plugs, &c. It is easily detached by a slight twist and pull, but it is impossible for the

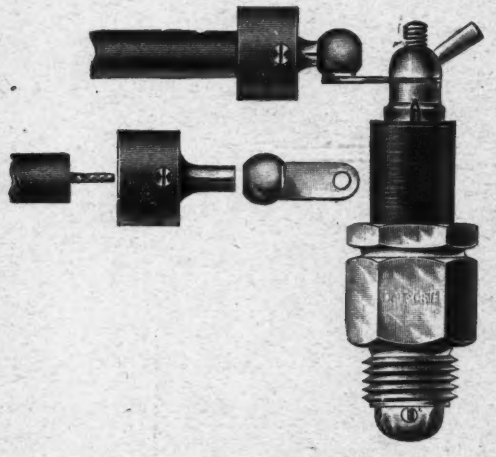


Fig. 83.—The "Konnectic" Connector.

connection to come apart through vibration. The flex cannot come away, as it is fixed tight by means of a small set-screw. It is claimed that easy inspection of sparking plugs is possible even when the engine is running, as the connector is well insulated and there is no fear of shock. The connectors, which are well made in brass and will last for years, are now being used by some of the largest motor-car manufacturers. They are supplied by Messrs. J. C. Lyell & Co., Ltd., 55, Victoria Street, S.W.

Insulating Wad for Lampholders.

In fig. 84 we illustrate a new patent lampholder insulating wad, of which Messrs. Millington & Everett, of King's Parade, Cambridge, are the patentees and manufacturers. It is claimed to give perfect insulation, to make the lamp thoroughly firm, and

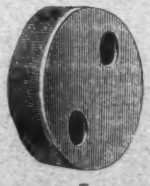


Fig. 84.—Insulating Lampholder Wad.

to keep the points of contact perfectly clean. The wad projects slightly beyond the bayonet points of the lampholder; thus when the lamp is pressed into position the wad is solidly compressed, forming a complete insulation between the sides of the holder and the bayonet points, and also keeping the lamp firmly fixed. The wad is made of heavy fireproof felt, faced with asbestos, through which two holes are pierced as shown. These holes correspond with the bayonet points. The wad is placed in position by simply pressing it in at the mouth of the holder. It is claimed that, especially on high voltage circuits, it affords an extra security against risk of short circuit.

(To be continued.)

ELECTRIC POWER DISTRIBUTION FOR THE RAND.

By ROBERT HAMMOND, M.Inst.C.E.

(Abstract of Paper read before the Engineering Section of the British Association at Johannesburg, August 30th, 1905.)

The idea of laying down central power stations for the purpose of affording a cheap supply of electric energy over extended areas is one that is being adopted in all parts of the world.

During a visit paid by the writer to Johannesburg during the early part of this year, he was struck by the fact that in such a dense industrial area as that included in the Witwatersrand, "power distribution" undertakings of magnitude were not in operation. Within a radius of about 25 miles of Johannesburg, calculating only the main shafts in active operation in producing and developing mines, there are some 150 shafts into the gold-bearing banket, and the number increases annually, the workings varying from "surface" to deep level 3,000 ft. below the surface.

There are already in use in the Rand mines, electric motors of a total capacity of about 20,000 H.P., and the number is being rapidly augmented. Electric energy is at present used for underground and surface pumping, for workshop driving, and in the cyanide works, for pumping the water, the solution and the slimes. In some mines it is used for crushers, for haulage, for the conveyor belts, and in the mills.

The writer not only advocates the adoption of electric winding, but he fully believes that almost every operation at present performed by steam power could more economically be effected electrically if the power were generated at a central power station supplying the whole of the mines. He has in mind:—Air compressing, haulage and pumping (both underground and on the bank), ventilation, stamp mills, crushing, sorting tables, tailing wheels and tramways.

It will be noticed that the writer places air compressing at the top of the list. The almost universal practice on the Rand is to work drills by means of compressed air supplied from works on the surface. This method is most uneconomical, as, owing to the inevitable leakage and friction losses, the distribution of compressed air through a long series of pipes results in a serious loss of power, variously estimated at from 50 to 75 per cent. of the power produced on the bank.

This should give place to a system by which electrical energy is utilised underground to work compressors placed in ventilated positions within 200 or 300 ft. from the workings. Under such a system, over 75 per cent. of the energy delivered to the electric line would be available at the tool.

In one important respect, the mines on the Rand work under conditions very favourable to the use of electricity. Pumping operations are generally continuous for 24 hours per day and 7 days per week; mining operations are continuous for 24 hours a day and 6 days a week; milling operations are continuous in most of the mines (some not milling on Sundays) for 24 hours and 7 days a week.

Having agreed that the use of electrical energy on the Rand has an enormous field, the question arises as to whether it could be more cheaply obtained from one central station or from separate works supplying one group of mines.

In order to fully appreciate the problem, it is necessary to carefully note how the costs of generation of electrical energy are made up. They divide themselves almost equally into: (1) Capital charges; (2) working expenses.

I.—Capital Charges.

1. Interest upon the capital invested.
2. Depreciation fund to provide for (*a*) the wearing out of the plant; (*b*) its antiquation.

II.—Working Expenses.

1. Coal, gas, oil or water used as the motive power.
2. (In the case of steam engines being employed) Water (*a*) for boiler feed; (*b*) for condensing,
3. Oil, waste and stores.
4. Wages.
5. Repairs and maintenance.
6. General expenses, management, &c.

A careful study of each item in turn will lead to the conclusion that aggregation of output tends to economy in every one of them.

I.—Capital Charges.

By aggregation of output and the resultant diversity factor, less plant is required, and therefore a lower sum has to be provided annually for interest and for depreciation.

By aggregation of output, plants of larger size can be used and the capital expenditure thereon minimised.

II.—Working Expenses.

Taking each item in turn, and confining our attention to steam-driven plants:—

1. *Coal.*—Plants of the largest size, which can only be used in works having an enormous output, use less coal per brake horse-power than those of smaller size. Before a recent Parliamentary Committee it was stated that, in the case of a particular type of steam generators, the 5,000-KW. sets used 25 per cent. less steam and the 10,000-KW. sets 33 per cent. less steam than the 1,000-KW. sets.

2. *Water.*—(*a*) For the boiler feed. The less steam used in the generators, the less will be the water evaporated in the boilers. (*b*) For condensing. The less steam passing through the generators, the less water required for the condensing.

3. *Oil, Waste and Stores.*—By means of the saving devices possible in plants of large size, there would be an economy possible under this head.

4. *Wages.*—There would certainly be an economy here, because the same number of men required to operate, say, six plants of 1,000 KW. could as easily work the same number of plants of 10 times the size.

5. *Repairs and Maintenance.*—Engineers are aware that the percentage on value disbursed on plants of large size is less than that on plants of smaller size.

6. *General Expenses, Management, &c.*—Here, again, it is a truism that large businesses can be managed more economically, proportionately, than smaller ones. Possibly, however, there is no need to dwell further on the now almost universally conceded proposition that aggregation of output leads to great economy in production.

In order to apply our general principles to the supply on the Rand, it is necessary to estimate the total amount of power, electrical and steam, used at the present time. This may be approximated from the amount of coal consumed annually, at, say, 400,000,000 H.P.-hours per annum, equivalent to an average output throughout the year of over 45,000 H.P.

In the case of 16 mines, which raised 316,371 tons of ore in the month of April last, 35,894 H.P. was in use. The total quantity raised by all the mines during the same period was 1,074,464 tons, and if dealing with 316,371 tons of ore necessitates a maximum of 35,894 H.P., the 1,074,464 tons would, as a mere matter of proportion, require 121,903 H.P.

Whatever, however, may be the total capacity of the plant, the broad fact stands out that a conservative estimate places the total requirements of the Rand mines at the enormous figure of 400,000,000 H.P.-hours, or, say, 300,000,000 KW.-hours per annum.

In order to arrive at the total capacity of a central power house to deal with this output, it is necessary to consider the load and diversity factors which would be obtained.

The success of a central power station depends entirely upon its ability to afford a supply of energy at very low rates. The extent to which aggregation of output leads to economy in working costs practically turns upon the excellence of the load and diversity factors which would result from the supply to a large number of consumers.

Turning to the conditions under which a power station for the Rand would have to work, it is evident that a very favourable load-factor would be obtainable. The load-factor of the plant at many of the mines is as high as ·5 or ·6, but of course it would be too sanguine to trust that all the consumers' demands would be as favourable. The writer is inclined to think that it would be on the safe side to assume that the average of the consumers' load-factors would be 40 per cent., equivalent to an average use of the maximum power for 9·6 hours per day.

On the basis of a consumption of 300,000,000 units per annum and a 40 per cent. load-factor, the sum of the consumers' maximum demands would be 82,200 KW.

On the assumption of a diversity factor of 60 per cent. and a 20 per cent. loss in distribution and transformation, a plant capacity at the generating works of 60,000 KW. would be required.

Dealing with steam generators, provision should be made for seven generating sets, each of a capacity of 10,000 KW., each set being capable of sustaining an emergency overload of 20 per cent.

On the assumption that one set would be occasionally laid off for overhaul, there would always be available for active use six sets with a total normal capacity of 60,000 KW., and an overload capacity of 72,000 KW., amply sufficient to cope with the estimated present requirements and the estimated output of 300,000,000 units per annum.

The cost of the power house, including steam generators, boilers, pumps, condensing plant, switchboard and erection is estimated at £980,000.

The estimate is drawn upon the basis that the primary voltage would be 6,600 volts; the mines within a radius of nine miles of the central station being supplied at that voltage. For the more distant consumers, step-up transformers would be used and energy transmitted at 30,000 volts to transforming sub-stations. Two such sub-stations would be required, one on the East Rand and one on the West Rand. The energy would be transformed down to 6,600 volts, and distributed to consumers at that pressure.

For the purpose of the estimate a power factor of 85 per cent. is assumed; bare copper overhead wires would be used throughout, carried on steel structures. The loss in transmission which has been worked to throughout, is about 7 per cent.

The 30,000-volt feeders to the east and west sub-stations are each arranged so as to be 50 per cent. in excess of requirements, so as to provide for reserve. The 6,600-volt lines radiating out to consumers are able to transmit the energy with a 7 per cent. loss over five miles, if load is taken off at one end, or a course of 10 miles if tapped off evenly all the way.

Ample provision is made in the estimate for the transformers necessary to give consumers, especially those who already have electrical systems at work, a supply at any voltage they may desire.

The sum included for the electric lines, transformers, sub-stations, &c., is £340,000.

In order that the plant may work at full efficiency, an ample supply of condensing water is necessary. Provision is, therefore, made for a tank to hold 100,000,000 gallons, the sum included for its construction and filling being £300,000. The complete estimate is as follows:—

Power house	£980,000
Electric lines, transformers, sub-stations	340,000
Storage tank	300,000
Land and road making	60,000
Contingencies, engineering and supervision fees, &c.	170,000
Working capital	150,000
Total	£2,000,000

Which it is suggested might be raised in the form of:—

Five per cent debentures	£660,000
Ordinary capital	1,340,000
Total	£2,000,000

The costs of working are compiled on the basis of an output of 375,000,000 units, made up as follows:—

	Units.
Used by consumers	300,000,000
Loss in distribution and transformation	75,000,000
	375,000,000

With a maximum load of 60,000 KW. the resultant load factor would be 71 per cent. With such a magnificent load factor as this, very low costs of generation are attainable.

Costs of Generation and Distribution of 375,000,000 Units per Annum.

Coal on the basis of 4 lb. per unit and 10s. 6d. per ton (of 2,000 lb.)	£393,750
Water make-up, 1¼ gallons per unit at 3s. 6d. per 1,000 gallons	82,031
Oil, waste and stores	3,125
Wages	52,000
Management, rent, rates, insurance, &c.	12,000
Repairs and maintenance, ½ per cent. on Capital outlay of £2,000,000; less working capital, £150,000 = £1,850,000	9,250
	£552,156
Add 5 per cent for contingencies	27,607
	£579,763
Capital charges.—5 per cent. on £660,000 debentures, and 10 per cent. on £1,340,000 ordinary capital	167,000
Reserve fund.—For depreciation and antiquation fund, and 2 per cent. on capital outlay on plant	37,000
Total	£783,763
Margin to the good	91,237
	£875,000

Revenue.

300,000,000 units delivered to consumers, at ·7d. per unit	£875,000

It will be seen that on the basis of a payment by the consumers of ·7d. per unit, there would be sufficient profit to provide 5 per cent. on £660,000 of debenture capital, and 10 per cent. on £1,340,000 of ordinary capital, after setting aside the sum of £37,000 per annum to a reserve fund to cover the depreciation and antiquation of the plant.

It will, I think, be agreed that these figures are sufficiently favourable to support the idea of one central electric station for the Rand; but it will be seen that they are based on the assumption that water storage of 100,000,000 gallons is possible, and that a matter of 470,000,000 gallons of water per annum, or, say, 1,300,000 gallons per day, are available for making up the losses by evaporation. In making up the estimate of cost of working, it is presumed that this quantity of water will be available at a cost of 3s. 6d. per 1,000 gallons.

Doubtless, if a good supply of water were available, it could be secured at a lower figure; but the serious question in such quantities at one central spot is to permit of the daily evaporation of so large a quantity.

Assuming that the demand from mines on the east of Johannesburg would roughly be double that from the west side, the ideal position for the power house is about 8 miles to the east of Johannesburg.

Let us presume for the purpose of illustration that ample water were available at Vereeniging at a distance of, say, 35 miles from Johannesburg.

In this case it would be necessary to add to the estimate of capital expenditure a sum of, say, £80,000, for the construction of a weir dam to provide a reservoir as a stand-by in times of drought, and of the necessary line of pipes for inlet land return to the lower level.

The generating station would be alongside the river, and the whole of the energy would be transformed up to 70,000 volts. The whole 50,000 KW. would be transmitted to a central point in Johannesburg by means of three sets of transmission lines, each consisting of three cables. Six of these cables would be sufficient to transmit the whole 50,000 KW. with a loss of only 6·7 per cent. The other three cables are therefore available as spares.

In addition to the central transforming station at the Rand, to which the trunk lines would be connected, two other sub-stations would be provided, as was the case with the central generating station, one of these being situated on the East Rand and one on the West Rand. Calling these stations A (west), B (central) and C (east), the whole of the energy would be received at B at 70,000 volts, and rather more than one-third of it would be transformed down to 6,600 volts, and this would be distributed to consumers within a radius of about 8 miles at that pressure. The remainder of the energy would be transformed down to 30,000 volts, and would be transmitted at that pressure to A and C. Here again a further transformation would be made to the distributing pressure at 6,600 volts.

The total cost of the trunk feeders and poles, additional transformers and sub-stations, would amount to, on a liberal estimate, £200,000. On the other hand, the outlay of £300,000 on the storage tank would be avoided.

There would, of course, be an increase in the cost of the transmission of the energy, but this would be more than compensated for by the lower price of the coal and water at Vereeniging, always presuming that arrangements could be made for the use of the Vaal River.

If such arrangements could be made, the future central power distribution station for the Rand will probably be situated there, and the supply given at ·6d. per unit.

The question will then resolve itself into a purely commercial one, and the mine owners throughout the Rand will have to decide whether it will pay them better te draw their supplies from a central station or to combine to use their own electric installations.

There is little doubt that those who are at present only using steam power would find an economy in adopting electric power.

In this connection it is significant to note that on the north bank of the River Tyne, in spite of coal being available at very low rates, 50,000 H.P. of steam has been displaced by electrical power during the last two years, the supply being drawn from the central power distribution works situated in Newcastle-on-Tyne.

In the discussion on the paper, Mr. Sidney Jennings said one of the important points to be considered was as to whether enough allowance was made for antiquation of plant. It was a matter of pounds, shillings and pence to the capitalist and to the engineer who advised him. If it could be proved without doubt that a central power station would be vastly more economical, then he thought the capital, although huge, would be forthcoming. They had on these fields central power stations of very much smaller proportions than the one advocated by Mr. Hammond. The Rand Central Electric Works were selling at 4·1d. per unit, whereas Mr. Hammond suggested that on a very large scale it should be generated and sold for 0·7d. per unit. As to electric winding and air compressing by means of electricity, he last year paid a visit to the chief collieries in Westphalia and in Belgium, and he was immensely impressed by the power and facility with which electric winding could be applied on these fields.

Mr. G. Henning said it was easy to find fault with the Rand engineers for not putting more electrical power into use, but they should remember that a few years ago there was no Rand, and plants had to be put down step by step. He was quite certain that if Mr. Hammond were to offer them power at the price he mentioned, they would all take his power.

Mr. E. P. Rathbone pointed out that with the power centralised in the way proposed, if anything went wrong with the centralisation the whole of the mines would be dislocated.

Mr. A. Siemens said they had heard every speaker say that the real criterion as to whether the thing ought to be introduced or not was, in commercial and industrial matters, the cost. In electricity, where the capital outlay was so very heavy, the charges in interest and antiquation were the main factors in deciding the matter. Mr. Hammond had told them that the load factor in the mines was at present very high—·5 or ·6. What would they gain if they made a central power station? He did not believe that that wonderful economy would be effected simply by increasing the plant to wonderful sizes. He thought that 2,000 or 3,000 KW. plants were big enough, for they were handier. Mr. Hammond quoted Newcastle-on-Tyne, and said that the North-Eastern Railway Co. were taking their supply from the central power station. He (Mr. Siemens) believed they paid ·45d. He had been over the Liverpool Electric Railway, and he was told that they got their units at ·33d. They had placed their station half-way between Liverpool and Southport. It had not been at all proved that a high power central station would necessarily be cheaper than smaller stations.

Mr. Spengel (Rand Central) pointed out that on the Rand they had comparatively modern plant, and therefore the chance of saving much from electric power supply was not quite so favourable. It might be possible to supply from a plant having a capacity of 60,000 KW. at ·6d. But this was based entirely on the assumption of a large load factor, and what were they going to do until this state was reached? There was probably no mine which would enter into contact with them now for, say, over 1,000 KW., and new mines generally started at 15 or 20 KW. Until the supply reached the 60,000, the fixed charge per kilowatt would be rather high, and in that he saw a commercial difficulty.

Portmadoc Electric Lighting. — The U.D.C. has declined to entertain the offer of the North Wales Power and Traction Co. to supply energy in bulk.

OVERHEAD CONSTRUCTION.

By ROBERT N. TWEEDY.

What a world of too much to do this is. Technical journals come in by every post one might say, proceedings of societies come on top of them, and the daily papers fill up every chink, so that if due attention were paid to all we should have no time to do anything but read and none to make use of our reading. The congestion of traffic in London streets is as nothing to the congestion of reading matter in many a man's study, such a congestion as no Royal Commission, nor a dozen of them, could ever clear. The real want of this age is an auxiliary brain for every man who cannot manage with the one given free by Nature; a kind of memory pot into which the contents of all the articles and books we want to read and cannot now from sheer lack of minutes, might be poured; an automatic sieve, and digester, too, to deal sub-consciously with the chaff and tares of which there is so considerable a proportion in modern writing.

The writer marked for future perusal the paper on "Overhead Equipment," read by Mr. Sayers before the Tramways and Light Railways Association last January (reprinted in the *Tramway and Railway World* of March 9th), but found no leisure just suited for that kind of amusement until now, which must be the excuse for referring after so many months to something which by present day canons ought to have been decently buried and forgotten long ago. However, there are certain points in and arising from that paper which will bear exhumation, although it is too much to hope that they can be given new life.

Poles have become gradually larger and larger since the date of the first trolley lines, and this not because the weight of the trolley-wire between spans has increased appreciably, or the other factors altered proportionately, but, so far as can be gathered, from the ever-increasing unbalanced stress put on the span wire. Poles are raked out of all reason, and pulled into the vertical at whatever cost in tension, not with any relation to the effect of the trolley wire on its supports, for if that only were considered a fraction of the rake would suffice. That this is so can be verified by observing the tautness of the span wires in most places. Unreasoning habit, fostered by the evil practices of constructional linemen, has led us into calling for such poles as the Standards Committee has selected, whereas an equally satisfactory pole to correspond with each of the three standards, but many pounds lighter in weight and of proportionable diameters, would have been chosen if the evidence given before the Committee had been derived from witnesses unblinded by custom. Much of the outcry at the ugliness of the overhead system might have been avoided if poles and bracket arms had not grown so huge. Our eyes are accustomed now to rows of monstrous columns along our streets, and the sight of anything smaller would be sure to give rise to a sense of danger.

This cry of ugliness has been strangled for the time now that Corporations have not the money to spend on surface-contacts or conduits, but the tramway builders have been their own worst enemies in this business, for they have given just cause for complaint by drawing attention to every ugly feature. No doubt resort was had to superlative ornamentation in the first place in the hope that æstheticism would be appeased, and it is only of late that people are beginning to understand that heavy bases, ornate collars, elaborate scroll-work, bracket arms extended backwards to give an effect of balance, and spiry decorated finials capping all, partake of the superfluous, and succeed in doing the very opposite to the intention.

Not only are elaborate trimmings artistic errors, they become positively economical objections in some cases. Lines are by no means unknown on which irreparable damage has been done to the most important section of the poles by galvanic action between the lead with which the constructors sought to make the bases watertight and the mild steel. This erosion may not be discovered until a pole is removed for some reason, when a cincture is found bitten into the pole at the line of caulking.

Whether the caulking has been done with lead or less dangerous material, it is the universal practice to make a

joint which is not intended to be broken during the life of the line. How, then, fares the surface of the pole inside the base? The visible portions are painted every year—should be, if they are not—but not so the invisible. Few seem to remember that layers of metal, in the form of oxide, are peeling off every year under the bases. But that is the case however much the top joint may have been caulked. Moisture creeps up from below, and sweating takes place inside until the first inadequate coat of paint is lifted and the ravages of rust begin and continue unchecked.

As with the bases, so with the collars, which cover and hide with yet greater obtrusion the returns formed by the junction of each two sections. These are not caulked, and are not the cause of galvanic pitting, but they conceal the sad effects of the rain which is trapped by the ledge, and as a general rule the painters have no orders to lift them to paint underneath.

If poles are to be trinketed with redundant castings which catch the eye and conceal the weather, let them not be responsible for the early death of the poles themselves. Better by far than the present practice is it to leave a clear thoroughfare between pole and base, and to make proper provision for ventilating and draining the base, but incomparably better is it to have no base at all, nor any collars, for then the heavy depreciation which goes on quietly and surely when bases are fixtures and collars are never moved will cease.

Primarily bases are intended to protect the poles from errant vehicles and mutually to protect the vehicles, but that reason has ceased to exist with poles made of steel and planted on the footpath. Certainly a base subtracts from the effective road width, and as certainly to minds free from the prejudice of custom it has the reverse of an ornamental effect.

Finally, if the considerable cost of these accessories is saved by their omission, the only valid reason for collars can be set aside by the adoption of one-piece taper poles, which have so many advantages over the sectional poles. As Mr. Sayers informs us, they are somewhat dearer, but the bases and collars are dearer still.

While rust and galvanism are sapping poles from the outside, potent rust plays its part on the interior. Whether this is caused by direct rain which entered after erection and before the pole was capped, by sweating, or by other ways, matters not. Caused it is, and the obvious cure is to ventilate and drain the pole until it can happen no longer. This is easily done on poles not yet erected, and can be carried out at moderate expense when they are in position. Probably the finest solution of the matter is to fill the whole pole with concrete after treating the interior with paint or other preservative, for that will add considerably to the strength of a pole, and prevent for ever the attack of rust.

This subject of corrosion and erosion of mild steel poles (it is a well authenticated fact that mild steel suffers from these diseases in much higher degree than wrought-iron) is not one to be dropped lightly. It is a serious and present danger to all those tramways on which no precautions have been taken against it, and at the rate of wasting which has been observed by the writer on poles removed from all kinds of localities, it is to be feared that long-continued neglect will end in the absolute destruction of poles even before the termination of the usual 21 years' lease or the 25 years' loan.

When Mr. Sayers says that "it is far better to let the P.W. construction get a good long start of the overhead," he has in mind, as he says, the uncertainty of P.W. plans, but the most economical way to work is to have the overhead construction always at least a little ahead of the track, so that advantage can be taken of electricity, supplied probably by a temporary plant, transmitted to work trains and track tools. To obtain the many advantages arising from this procedure is a matter of preliminary organisation, and it is to be regretted that practical engineers who realise the importance of machinery in economising labour have not more to do with these preliminaries. The track costs more than any other item in the construction of a tramway, and a percentage saving on its cost means a correspondingly larger amount off the capital charges. Rail benders, rail drills, riveters and all the rest of the portable tools could be worked electrically, or electro-pneumatically, and an immense deal of carting could be saved if live trolley wires were available up to the rail head.

On interurban or country lines, where the cost of construction has to be kept down to the absolute minimum, still lighter poles may be used, as there will be little objection to them being stiffened by bow-strings in the same way that the Post Office stiffen wooden poles at curves, and light steel poles properly maintained are probably better in such cases than the wooden poles which have been used occasionally.

Mr. Sayers would have anchors at the ends of all curves, at section insulators, and at every quarter mile in addition. If trolley wire is erected properly there is little necessity for all this extra wiring, and the less of it there is the better from every point of view. In no case of a trolley wire breaking will more than one span be affected if the ears are attached as securely as they should be. On paper, of course, it does look as if a break in one span would send some effect travelling down the line on both sides of the break; but, in fact, nothing of the kind occurs, and the damage is localised strictly.

Even section insulators as made now are independent of anchoring, and so are splicing ears if they are designed to receive the ends of the wire at an angle as obtuse as possible.

Anchoring, it may be said, is required chiefly as a means of preventing broken wires falling to the ground, not so much to prevent the damage or deformation of the line extending, and it follows, therefore, that anchors are to be put up in the course of maintenance rather than as a matter of construction.

As the wire at splicing ears, section insulators, and other special points begins to wear, anchors ought to be thrown over the fittings and attached by half ears to the wire on each side, and it is the duty of the linemen to do this in good time. "Broken trolley, bad lineman" is a saying that has more than an element of truth in it on most occasions.

This anchoring for protection from the effect of trolley wires breaking used to be done on the "trap" principle by

Fig. 1.

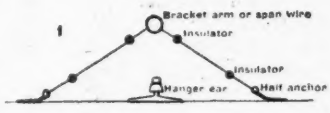
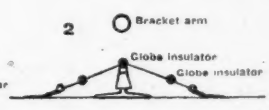


Fig. 2.



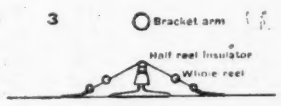


Fig. 3.

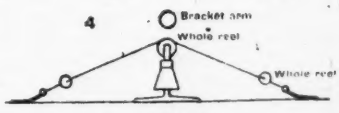


Fig. 4.

taking the wires back to the next poles, and so forming a V between the trolley and anchor wires. This arrangement has not been seen on new work since the Board of Trade frowned on it, not without due provocation, and it has been superseded by anchoring in the same vertical plane as the trolley wire. This has been done in several ways, as illustrated diagrammatically above.

Fig. 1 shows a bowstring suspension from a bracket arm, with two insulators, usually globe strains, on either side in order to maintain double insulation. This arrangement always looks heavy, and requires too many insulators. The equivalent span-wire construction has a special anchor span in place of the bracket arm in fig. 1.

Fig. 2 shows a better arrangement so long as the globe insulator stays in its place on the hanger, and fig. 3 provides better for this by means of a special insulator made like half a reel or bobbin insulator, retained in position by pegging the hanger cap; but the arrangement shown in fig. 4 is preferable to them all, although it calls for a special hanger cap. The cap is cast with two trunnions on top, which are made to support a complete reel insulator, and the anchor wire simply lies in the groove and is attached at each end

to other reels and so to the half-anchor ears. The cost of the cap is little more than that of the ordinary cap, while full advantage can be taken of the cheap and trustworthy porcelain reels.

This vertical style of anchorage cannot take the place of the horizontal style when strain is to be taken off a length of trolley wire, but, as stated above, that kind of anchoring can be reduced to small proportions in practice.

(*To be concluded.*)

A PROVINCIAL'S VIEW OF THE EXHIBITION.

THE note of the Exhibition is struck before Olympia is entered, if the first visit is paid at night when the row of flame arc lamps is flooding the accommodation road with a wonderful ruddy light, for there, sandwiched between the glorious globes of yellow-red fire, one dimly sees the rival light as a square inch or so of cold green phosphoresence, looking for all the world like so many chips out of an imitation moon shining by the reflected, and transformed light of the electric suns. Nothing but the glow of the mantles is seen, for the power of the arcs overwhelms any radiation from them.

That is the key-note which tunes the visitor to the vibrant lessons awaiting him inside.

Olympia will teach the provinces, and London, too, that electricity has not passed from its infancy straight to its dotage, that it has not just flitted across the sphere of the gas lamp for a moment and so into the region of failures. It will bring home to householders, to factory owners, and to public bodies that electric light is not fighting only with a carbon glow-lamp in one hand and the old arc lamp in the other. Trenchant weapons these against any comer, and ever gaining keener edges as the battle rolls along, but the cause is daily strengthened by the creation of new and heftier blades.

Although the Exhibition satisfies the farmer that chaff can be cut and cream separated by electrically-driven machinery, sets the hotel proprietor thinking about the advantages of cleaning knives and boots by the same means, persuades the brewer that bottling and corking machines are best driven by motors, and demonstrates to the engineer that steam, belts and shafting are obsolete, it is, above all and before all, an exhibition of electric lighting. It is necessary that it should be so; the times demand it. Collieries, factories and workshops by the score give their evidence against steam engines for anything but driving dynamos, and nothing but hard times and shallow pockets prevent an enormous extension of motor use; but reports from the realm of lighting make clear that the truth about electricity is not known. The hold of the incandescent mantle is far stronger than we knew, and it must be loosened by light let in on every intelligence obscured by ignorance of things in being.

This office the Exhibition will perform in part, but much rests with the provincial engineers.

The glare of Olympia does not irradiate Land's End, but its lessons will carry far of their own weight; they must be pushed and pushed until the incandescent mantle is no more and gas takes its own place.

Circulars, catalogues, travellers, all perform their part in the education of engineers and of the nation, but an exhibition such as this offers a chance of saturation with the deeds of progress, which is of more lasting value than piles of leaflets, shelves full of catalogues, and hordes of travellers. For that reason it is imperative that as many as are connected with electricity shall see as much as they can of the things at Olympia, which are going to do so much towards the approximation to our ideal.

The visitor does not leave flame arcs outside the building. They are everywhere. On the four corner posts of many stands, in rows inside the stands, along the very ridge of the roof they shine prominent and unmistakable. Here the flame arc makes its *début*, one may say. Hitherto it has been burning publicly in patches only; samples here and there, batches at wide intervals over England.

The pioneer lamp failed, but out of its ashes have sprung innumerable others, of which some will live long and happy lives. That the flame lamp as a type is at once the most brilliant and the most economical electric lamp may be taken for granted; as an individual that which burns the cheapest carbons for the longest time with the least flickering, and the least light obscuring and corrosive deposit will secure the public favour, so long as the price is right.

If that lucky lamp is a British production, so much the better for Britain, but it is evident that the odds are on the foreigner, if numbers count. Certainly the lamp which appeared to give the steadiest and most pleasant light was British-born and made. It makes use of a magazine rifle clip to reload the carbon holders, and is enabled thereby to burn thin common carbons for 40 hours and over, without re-trimming. The enclosed arc lamp has spoilt us in this matter of trimming. Before its day we had to provide for daily attention to the carbons, and it seems that we are on the brink of returning to that state of things, after accustoming ourselves to the 150-hour enclosed arc. If the difference can be made less, or removed altogether by some magazine arrangement, there will be no remaining objection to the new lamp, but whether the hours of burning are short or long, the next 12 months will produce flame lamps which will make the use of white arcs an economic blunder.

The flame arc is old compared with the mercury vapour lamp, which was perhaps the greatest novelty in the Exhibition. Much has been seen in print about the Cooper-Hewitt and the Bastian lamps, and trial lamps of the latter type have been in use to a limited extent, but the majority of engineers, to say nothing of the general public, hardly realised that the mercury vapour lamp has come out of the laboratory into the practical world, until they saw the shimmering stand of Messrs. Rumney & Rumney.

What part that lamp will take in the unplayed acts of electric lighting it is rash to forecast, but of this we may be reasonably sure, a lamp which vies with the arc lamp in point of efficiency, burns for an extraordinary number of hours before it requires any kind of attention, keeps up its normal candle-power throughout its life, and burns always with a steady radiance even when subjected to wide variations of pressure, is an article which may not be cast aside lightly, because the colour of its light is peculiar. The very strangeness of the colour will make the use of the lamp in private houses and public buildings intolerable for some time to come, but that objection sinks into obscurity when the lighting of side, and even main streets, and of factories and workshops is in question; and the only points on which uncertainty must be removed by experience before the lamp is accepted finally, are those concerning average life and sensibility to atmospheric conditions. Compared with the miniature arc, prices are quite reasonable, even now, but we may expect with confidence that demand will operate to reduce them still more, and that the lamp will eventually become a most active competitor for side street lighting.

The mercury lamp has to find its field first in the streets where people can become accustomed to a colour so different from that of any other light, then it may get within four walls, and gradually attain the fulness of its hope.

Was it the feeling of others besides the present provincial that there is more certainty about that lamp than about the tantalum lamp? The visitor to Olympia has no more doubt about the existence of one than of the other, for both are well represented, but one felt that the latter has to live much longer before anything very definite can be said about its permanent value or comparative excellence.

While the mercury lamp will compete with the incandescent mantle, the Nernst lamp and the small arc, the Tantalum—and, at the same time, the Osmium—will be required to prove itself against the carbon filament and the Nernst. How it will behave under the stress of competition, from which the factor of novelty is omitted, remains to be seen; but it is probable that at the present time the average useful life under the conditions which are to be expected reasonably, is too short to make the lamp a serious competitor with either of its rivals.

The filament is so long, and becomes brittle so early, that a pessimist might be inclined to remove this lamp from the list of entries for the domestic lighting race, and he would add that the unit of light is rather too large to appeal to

owners of rooms under 20 ft. square, now that the general pressure of supply is 200 to 220 volts.

One left the Exhibition with a sense of overpowering dazzlement, and an idea that one could never again read under anything less than a dozen arc lamps at 6 ft. Never were one's poor eyes assailed by so many candle-feet simultaneously. What the Olympian atmosphere would have been like under the befouling influence of an equivalent candle-power in gas lamps one shudders to think. The result would be an explosive as well as a suffocating mixture.

One welcomed the reminder of Messrs. Geipel & Lange that there is such a thing as a "turn down" lamp, for it helps to refute the recurring statement of the gas men that nothing but the extremes of full brilliance or extinction are possible with electric lamps except at an enormous sacrifice of efficiency.

The supplementary filament in the "turn down" lamp serves its purpose much more readily than the by-pass on a gas lamp, and without the notorious inconveniences attaching to the latter.

While it was the object of the rest of the exhibitors to display their lamps as nakedly as possible, the Linolite Co. gave everyone a much-wanted object lesson in the effective distribution of light. The system of diffusion by indirect reflection will become universal later on when people discover that what remains of their eyes is worth conserving, and suppress their acquired habit of looking for points of intense light.

Those who have taken advantage of the goodwill of the exhibiting lamp makers to supplement their glance at the miniature factories of which the stands consist by following in the real factory the manufacture of a glow lamp from cottonwool to cardboard travelling case, will feel more than ever that it will take a lot of beating when made with such scrupulous care; but we have to face the possibility of recent innovations superseding the old forms sooner or later, although the day may have arrived already when improvements in the manufacture of the filament will postpone the event indefinitely.

The carbon glow-lamp industry is too vast, and its products are too well known, for sudden decay and dissolution to overtake it. The new lamps and the old will find their own places in time, while all will join forces to thrust the gas lamp into outer darkness.

The generation and application of ozone has been treated so extensively in these pages that one was glad to have an opportunity for examining a real live ozoniser on a practical scale—something that will deal with the whole air supply of a building, or will purify water and sewage at small cost.

An ozoniser will be a desirable adjunct to an installation of electric light in any building in which ventilation has depended on the superseded gas jets.

The steel-core concrete conduit strikes a new note in cable laying, and with prices less than those of stoneware conduits, the advantages seem to be numerous.

In the matter of cooking and heating by electricity, one looked admiringly at the pots and pans, and at the charmingly designed radiators, with a sigh of regret at the price of gas.

In medicine, electricity has the field to itself, and the Dowsing show was useful as an indication to the layman of the advances in this direction. Perhaps the day will come when another peak will be added to the chart of the lighting station by the light baths taken off the mains every morning before breakfast.

Undoubtedly there are many small domestic uses to which electricity will be put increasingly, but another exhibition or two must come and go before the heavier household heating work is taken out of the hands of the coal and gas men.

Redcar Electric Lighting.—The U.D.C. has decided, with the approval of the B. of T., to transfer the prov. order to the Cleveland and South Durham Electric Power Co. on terms agreed upon. By this action the Council's expenses in obtaining the order will be refunded.

MAKING ONE'S LIGHTS COUNT.

(An American View.)

Considering the enormous increase in business which most of the large central stations have enjoyed during the past decade, it is strange that in so many instances consumers have learned so little about the efficient use of their installations of incandescent lamps. In some quarters the opinion prevails that if the central station sells the current it makes little difference whether the consumer's equipment is effectively employed or not, and that it is all one to the supply company where the lamps are placed as long as the monthly remittances are regularly received. Such views are not in accord with broad conceptions of the relation of a central station to its customers, and, in the long run, are destined to go to the wall.

The use of the electric light in advertising is a case in point. There is, perhaps, no better index of a town's progressiveness than the manner in which the streets in the commercial district are illuminated after business hours. In the great cities of the United States the electric sign has now attained a tremendous foothold; the Chinese laundry, the Hebrew merchant, hotels, restaurants, theatres, and retail houses of every description have been brought to the point of realising the far-reaching effectiveness of illuminated signs against the natural background of darkness in comparison with the dead level of even illumination accorded to all objects by daylight. The electric sign compels attention—there is no escape from it, and even the smaller cities and towns are beginning to see the point.

Many enterprising cities of middle size, not to mention the larger towns, are very poorly provided with street lights, even in the business districts. Perhaps there is no more difficult problem in the field of artificial illumination than the adequate lighting of streets. Few cities are in the financial position to light even their important streets to a degre of brilliancy much in excess of that required for tolerably safe, personal, locomotion along the sidewalks. The fact is, if it were not for commercial lighting for advertising purposes, few of our cities outside the great metropolitan centres would present any special attractiveness down town by night. The advent of the electric sign and the use of window lights until the late evening hours by enterprising merchants have jointly wrought greater changes in the habits of our smaller cities than are generally realised. Time was, and not so long since, either, when an after dinner stroll along the principal streets of a town of 50,000 inhabitants was a gloomy and depressing experience, attended by occasional personal risk and cheered by nothing brighter than the flaring gas jets of some saloon of fruit stand. To-day, in live communities, throngs of pleasure seekers crowd the important thoroughfares every evening; and, although the trolley may justly claim a large share in this improvement, there is no doubt that the lion's share rightly belongs to the incandescent lamp. This being so, it is a pity to overlook the possibilities of effective illumination in any individual case.

In a nutshell, the electric sign and the window light present two exactly opposite problems. The former is the object of attention, and the latter a means to an end. If the sign is legible at reasonable distances, it matters little to the observer whether the lamps used be "16 or 4;" but, whatever the candle-power, legibility is the first essential. It is not uncommon to find merchants spending considerable sums upon current for high-powered but only fairly legible signs, when the same, if not better, results, could be secured by the use of smaller lamps spread farther apart. In incipient cases of this kind, it is surely worth while for the central station man to advise either installing a sign of wide spacing with large lamps or one of narrower dimensions and smaller candle-powers. If the merchant be made to see that he is receiving adequate return for his outlays each month, it will surely count in the central station's favour when extensions are planned, or references and recommendations made to prospective customers.

Window lighting is almost a specialty in itself in these days, and the need of experienced advice is seen on every hand. Here is where the central station stands an admirable

chance of being doubly useful to its customers. The average consumer does not realise that the lights themselves are merely auxiliaries to the display of his goods; he does not know that two 8-c.p. lamps, intelligently located, are almost always more effective in window lighting than one 16; and he often thinks that the display of the lamps beside the goods add to the attractiveness of his exhibit. Questions of this character need the skilled attention of the electric lighting engineer, and it is in the power of the central station to demonstrate to every progressive customer that judicious adaptation of means to ends, which results in a better quality of illumination at the same profit for each unit of expenditure, more lasting satisfaction on the part of existing clients, and a broader increase of business throughout the community.

EDUCATIONAL, AND OTHER FADS.

By A COLLEGE LECTURER.

A very great deal has been written and spoken regarding the training of engineers chiefly by professors and consulting engineers. Recently, one of these made the suggestion that courses of lectures might be delivered by old students of the College who were engaged in some special branch of engineering.

Now, this suggestion can hardly be called new, and in one technical college at least "experts" have lectured chiefly, of course, in the evenings, for years. Whether or not their efforts are crowned with success, the writer cannot say. In many ways, however, the suggestion will do good in bringing before the public the necessity for specialisation in electrical engineering teaching work, and it will tend to do away with the antiquated idea of a "professor" with plenty of white shirt and side, who lectures on everything connected with electrical engineering.

It is a strange fact that technical colleges have very often followed the example of the old and hoary Universities, by appointing professors to teach "everything" instead of obtaining a series of lecturers. Frequently also in appointing a head or principal of a college, teaching experience is rarely considered of any importance. Perhaps this is done so that the man appointed may make original suggestions on the Carnegian principle of making a telegraph clerk a chief engineer of, say, a steel works. It is a curious thing to think of the feelings of such a man, who has spent the greater part of life in the seclusion of his college rooms, dragged forth to boss some institution where there is the usual heterogeneous collection of trade classes. He must feel something like Kipling's captured lancer, and one cannot help "wondering how he likes it."

The above, however, is a digression, and to return to the professor, we frequently find, as if electrical engineering was not sufficient, that the professor professes physics as well. In other cases it is tacked on to engineering, and sometimes the engineering and electrical engineering laboratories are a wondrous combination. Of course a lecturer is generally appointed at a moderate salary to do the work of the professor in this case, and the writer is aware of a college which has appointed "assistant professors" at moderate salaries, and in this way has almost doubled its output.

In the meantime, however, assistants of any description are poorly-paid people: the salary ratio:—

$$\frac{\text{Professor}}{\text{Assistant}} = 10 \text{ approximately.}$$

However, with the advent of clearer and saner eductional ideas, the decadence of the professor will be accelerated; but of course, so long as the popular craving for these creatures remains and requires to be satisfied, colleges will groan for funds, and suitable lecturers will remain scarce.

Yet in looking through the advertisement columns of any electrical engineering paper, one cannot help being confronted with the march of specialisation in this industry. For example:—

"Wanted, an engineer with experience of H.T. three-phase working . . . ."

"Wanted, a mains superintendent with special knowledge of electrolysis troubles . . . ."

"Wanted, an engineer with experience of the three-wire system . . . ."

And so on.

In teaching, specialisation is a thing of the future, and meanwhile the enterprising Teuton has it all his own way. The British public seems to consider a professor necessary, and sticks to him as Rankine's workman sticks to his "three-foot rule."

The writer has experienced at college many professors. There is the professor who does consulting work, who utilises the college in his spare time, who has forgotten how to integrate $\log x\,dx$, and who attends to the telephone bell at intervals during the lecture. The writer, being only a student then, failed to appreciate this professor at his true value. He did not recognise that all the time he was gaining information, getting practical wrinkles, far more useful than integrations. The lesson seemed to him to be "make money." Recently another celebrated engineer has blurted out that this is really the case, and if this is so, why not look the facts in the face, and equip our colleges correspondingly?

It would interest the writer very much to know what the occult knowledge is of which practicians make such a talk?—Is it anything which can be communicated to students, or which might supplant other more academic studies? Is not a great engineer rather a kind of freak, a person who possesses many valuable qualities so co-ordinated that he is able to make money?

There is the professor who writes books, and who bores his students by giving them proofs to read in their "spare time." He is the most harmless of the lot.

There is the professor who is a manufacturer, or to use the expression of his more jealous brother professors, "keeps a shop." The writer recollects such a professor of engineering who probably having a mania for works costs, &c., used to waste precious hours teaching the rudiments of abbreviated arithmetic!! The absurdity reached a climax when he pulled out his slide rule to correct his working. Yet, here was a practician of the best type.

Most of the best paid professors in this country are allowed to do consulting work and thereby gain a little experience and cash. Most of the worst paid professors in this country are *not* allowed to do consulting work. Lecturers are always debarred from this by a clause in their agreement with the college, for which the writer supposes the professor of the department is largely responsible. In some Universities, of course, this is not the case. The writer would welcome the more enlightened policy of giving the students more outside experience and less "talky talky," but does not see how it is to be done with the present day curricula to get through, except by omitting many "intermediate methods" of doing things referred to below.

Again, there is the wretched student to consider. This person is bandied about from one department to another between, say, 10 a.m. and 4 p.m. each day from chemistry to mathematics, then physics and laboratory, and so on. In many institutions a great deal of his time is really wasted over "fads" of the professor, or some absurdity of the curricula. To enumerate only a few of these, there is the professor who insists on, say, "Windmill design," to the exclusion of everything else. Very useful no doubt to a very few, very useless to a great many. Again, the laboratories may have been designed by a "practician" who has had no teaching experience; and this, of course, is fatal to the students. Practicians seem to imagine that the electrical engineering laboratory should resemble an engine room as much as possible. There should be switchboards, and as many fixtures as possible, and all the wires should be run out of sight, or in tubing, and when you turn a handle the armature begins to rotate.

The writer has often wondered why there were so many fixed connections in a laboratory. Yet the waste of time over these is enormous, when one considers that every fixed connection has to be explained at least three times to a student in the course of a session's work; hence, if there are n connections and N students, the time spent over them can be calculated.

How often does a student ask, "What is this arrange-

ment for?" and the demonstrator wearily replies, "Oh, that thing! it was an idea of Prof. Bunkum's to enable you to put alternating and direct current on a motor at the same time. It didn't work, so it is never used." And again: "How do I connect up this dynamo to run as a series machine?" "You join A to B, Z to N, F to K, H and J, and don't forget to take the plug out of M, otherwise there will be a dead short."

Yet, in spite of years of this sort of thing, we see laboratories with many switchboards and fixtures at the present time! Sometimes students have a delightful time finding out what a machine with all its connections is intended for, and making a new diagram of these.

Another faddy thing is the C.G.S. system, some professors insisting on its use throughout the college course. Perhaps this accounts for the heterogeneous units adopted by dynamo designing people at the present time. Lately the writer had five drawings of a dynamo machine to consider. One firm used millimetres, another centimetres, another feet and inches, another feet and decimals of a foot, and so on. Why *millimetres* (!!) are so frequently used nowadays is rather puzzling; 580 mms. does not convey much idea of length to the British engineer, and a millimetre is no unit.

The writer thinks that the Engineering Standards Committee should recommend certain units to be adopted *in drawings*, and suggests the *foot* and *inch* as being quite good enough for most people at the present time. Later, when quart pots are abolished, perhaps we shall have a set of rational units, but introducing these meantime is merely adding fuel to fire. However, it is a little awkward, if one wishes to compare drawings hurriedly, to find that they have all to be reduced to a sort of N.T.P., which in its gruesome absurdity is quite startling.

Then, again, there is the idea of doing things on a large scale in some places, and machines of large size are used. Now, now doubt, large machines are better than small ones when expense is no consideration, but in the majority of places cheapness *is* the great desideratum. In this respect certain London Polytechnics compare very favourably indeed with other places blessed with more £ s. d. for equipments.

Again, every laboratory, however poorly equipped otherwise for teaching, *must* have its Kelvin balance, costing £60 to £80. As a rule, a large copper voltameter would be quite as instructive, and cost about 5s., and quite good enough for this class of student to work with. If this was done, perhaps we would find a voltameter in every little electrical engineer's shop for calibration purposes, and so many electricians would not believe that the strength of the solution affected the results appreciably. Yet, strange to say, although much has been spoken and written about calorific values of fuel, calibration of instruments, &c., it is *quite the exception* to enter an electric generating station where this simple calorific test of coal is regularly carried out, and if any standardisation is done, the instruments are compared with another instrument supposed accurate "once upon a time." But the scarcity of fuel-testing calorimeters is more extraordinary and inexcusable since the price of generating per unit depends surely on the calorific value to a great extent.

The teaching of engineering mathematics, too, has undergone a change, and now squared paper is all the rage. Every engineer now talks of finding the "law" of variation of some function. One often reads, "the accuracy with which these curves follow the quadratic or parabolic law is remarkable," whereas the "remarkability" would come in if the quadratic approximation *did not* follow the experimental results, in most cases. However, it seems mathematics is now to be regarded as a branch of mechanics, and perhaps, on the whole, better results will be obtained this way. Abbreviated arithmetic, however, is about as useless an accomplishment to a twentieth century British engineer as a knowledge of Chinese; slide rules, and four figure log tables, being very cheap now. It seems, looking at types of different examination papers, that our educational people delight in teaching, first of all, all sorts of methods of doing calculations, which are "shed" as the student gets more knowledge and experience. The writer wonders how long $s = \frac{1}{2} gt^2$ will be proved by algebraic methods, and what good this does the student—another stock question is the "simple pendulum" without using the calculus. Half a student's time, it appears, will be spent in learning methods which are to be "shed" later on. Why?

It seems to the writer that if a student would plunge into the calculus at once and spend a year or two getting it up, before he ever attempted to study dynamics or physics, a great deal of useless "Intermediate Science" methods of solving problems could be avoided, or he could study them by calculus methods right away, along with the calculus. That this can be done quite well has been proved over and over again.

In this way, perhaps, a student may develop into a "Captain of industry"—why they call them "Captains" the writer does not know, if there is a captain surely there is the Field-Marshal's baton somewhere?

But in any case the student must remember when he goes out into the world that to be a success there (and, of course, make money) he will require to resemble Magnano, of whom it is written:—

> In magic he was deeply read,
> As he that made the brazen head,
> Profoundly skilled in the black art,
> As English Merlin for his heart,
> He could transform himself to colour,
> As like the devil, as a collier.
> The cannon, blunderbuss, and saker,
> He was the inventor of and maker. (Hudibras.)

THE INFLUENCE OF ELECTRICITY ON POWER ENGINEERING.*

By W. B. ESSON, M.Inst.C.E., M.I.E.E.

The early seventies saw the inventions of Gramme and Von Hefner Alteneck, and the beginning of the electric lighting era. From those early days till now progress has been continuous. In 25 years the size of electric generators has increased from 5 H.P. to 5,000 H.P., from the machines which fed the Jablochkoff candles in the Avenue de l'Opera in Paris, to the magnificent triumph of engineering realised in the generators at Niagara.

It was not until 1880 that the first incandescent lamp factory was started on a commercial basis.

From 1880 onwards, power transmission made progress. Arc lighting work had taught manufacturers how to make machines for higher pressures, and the demand consequent on the invention of the incandescent lamp gave the necessary stimulus to development.

There was no such thing as transmission of power in the sense that we now understand it until the electric motor made its appearance.

About 1889, engineers on the Continent were faced with a very important problem. They saw in their waterfalls thousands of horse-power running to waste. They knew that by adopting electric transmission, this power could be utilised and distributed to great advantage amongst manufacturers scattered over a wide area, but they also recognised that success could only be obtained by the use of a pressure considerably higher than the 2,000 or 3,000 volts then in use. The problem required a considerable amount of study, the position being:—For alternating currents, pressure all right, but no motor available; for continuous currents, motors available, but pressure not high enough. As the supply of power was the leading idea, the system which possessed the motor had to be chosen, and continuous current was consequently adopted, with the brilliant device, however, of joining up all the motors in series and spreading the high pressure over the lot, while connecting the generators in series to keep down the pressure on the commutators of individual machines. In this system the current is kept constant, the pressure varying according to requirements, and at the date I am speaking of it does not appear that there was any other way of providing a general power supply. It says much for the engineering of the installations on this system, that they are in most successful working to-day, and what is more, they are being added to in competition with the three-phase system. A considerable number of installations on similar lines have been laid down, some of them of great importance. Amongst these is the Brescia transmission of 700 H.P. at 15,000 volts over a 12-mile line, and the larger installation for supplying La Chaux-de-Fonds with 2,400 H.P. at 14,400 volts over a 32-mile line. Another installation is at work transmitting 4,000 H.P. at 22,000 volts over a 34-mile line from St. Maurice to Lausanne, and there is in course of construction the largest of all, designed to transmit 6,000 H.P. at 60,000 volts over a line 114 miles long from Moutiers to Lyons.

Now a system showing such strong vitality, though working on what nine-tenths of our engineers would call antiquated lines, cannot be dismissed in a sentence. The facts are, that the system is going ahead in the face of the three-phase alternating system

* Abstract of presidential address to the Civil and Mechanical Engineers' Society. Delivered October 5th, 1905.

and is successful on a scale commensurate with many of the larger three-phase installations. The Americans say that the success of such a system would be impossible in their country, because the motors would not there get the careful and skilled attention given to them on the Continent. This may be so, but with a large plant and sub-stations the objection need not hold. In any case it is certain that every engineer will look forward with the greatest interest to the completion of the large scheme now in progress.

It was at the Frankfort Exhibition of 1891 that the problem of long-distance transmission was satisfactorily solved. A tremendous impetus was given to power transmission in Europe, and soon a large number of installations were working on the new system, transmitting power to distances up to about 15 miles, at pressures in the vicinity of 5,000 volts or so.

It was not until 1897 that any increase over the Frankfort pressure was made, but in that year the South Californian Power Co. transmitted power over 80 miles at 33,000 volts. Several plants were installed at this pressure with the object of finding out whether a still higher voltage could not be successfully employed. These experiments culminated in the Telluride Co. adopting, in 1893, a pressure of 40,000 volts for their Provo transmission, and at the present time there are several installations in the States working at this pressure. The Shawinigan Water and Power Co. is operating over a line 84 miles long with 53,000 volts. The Washington Power Co., the California Gas and Electric Co., and the Guanajuato Power and Electric Co. are all operating at 60,000 volts, while the Kern River Power Co. is busy with a line on which the pressure will reach 67,500 volts. This is for the time being the highest pressure in the world, but two companies are making provision for their apparatus to be capable of working at 80,000 volts, so that whenever suitable methods of insulation for this pressure are devised they will be able to adopt it.

In Europe the pressure on transmission lines does not rule high. The distances are not great, and under these circumstances it is preferred to keep the line pressure down to a figure which is possible to the generator armatures and does not require the use of step-up transformers. A most interesting example of a power installation in the Far East is furnished by the Mysore transmission of 4,000 H.P. from the Cauvery River Falls to the Kolar goldfield, a distance of 92 miles at 30,000 volts. In North Wales a pioneer hydro-electric transmission installation is close upon completion which will be supplying current very soon. The power is derived from Llydaw, on Snowdon, and there will be transmitted in the first instance 4,000 H.P. at 11,000 volts for the working of light railways in the district and for power purposes generally. A scheme which the Scotch Water Power Syndicate have in view is the transmission of 5,000 H.P. to the Vale of Leven from a hydro-electric power station, 22 miles distant, supplied with water from Loch Sloy, which is situated 750 ft. or so above Loch Lomond. Here the pressure proposed on the overhead transmission line is 40,000 volts. But the scheme is at present in the air, and whether the conductors will ever get there I would not like to say.

Unless the power transmitted is very large the lower the pressure the better, provided that it is high enough to allow of the transmission being carried out economically. It would be folly to assert that there are no greater risks with the higher pressures, for, as a matter of fact, with pressures of 40,000 to 60,000 volts "the highest intelligence, vigilance and excellence must be employed to avoid accident and ensure success." These pressures are not to be used indiscriminately or when they can be avoided. A large number of plants are operating at pressures between 10,000 and 20,000 volts, and of these it may be said that the overhead lines give very little trouble. The latter figure represents a voltage which can be produced in the armatures of machines of moderate size without difficulty, so this pressure may be considered a limit below which step-up transformers may be dispensed with. When we get much above this we enter a zone where we begin to experience the line troubles which very high pressures bring, without obtaining all the corresponding advantages they confer. It is very questionable, therefore, whether there should be any halting place between 20,000 and 40,000 volts. At 33,000 volts Dr. Perrine tells us that the special difficulties due to capacity, insulator size, erratic lightning arrester effects and switching begin to make themselves seriously felt, and it is just as well, if we have to re-design the apparatus with special reference to these difficulties, that we carry the pressure to the other extreme of the zone referred to, and so get the full return for our trouble. If high pressures are ever standardised, the figures for the standards will be probably 20, 40, 60 and 80 kilovolts.

With pressures of the order of 40,000 volts, quite a new set of phenomena is brought to our notice. In the first place, the insulators, in order to prevent flashing over to the supports, must be very much larger, and an increase of pressure from 20,000 to 40,000 volts necessitates their diameter being increased by 50 per cent. or more. A usual size of insulator for the former pressure is 6 in. diameter, while the latter should not be less than from 9 to 10 in., with the addition of at least one intermediate bell between the outside dome and the inside cup. When these high pressures are used the phenomenon of brush discharge has to be provided against. This results from the breakdown of the air as an insulator, owing to electrostatic strain set up in the space between the wires, and it was very thoroughly investigated by several leading engineers in America in 1893. Their experiments showed that while the loss of power due to this cause at 40,000 to 50,000 volts was, with the usual line construction, inconsiderable, after the higher figure was reached the loss increased rapidly. Prof. Ayrton has lately worked out the distance wires of different diameters have to be placed apart to ensure that with certain pressures there shall be no brush discharge. The cure of the evil is of course to keep the wires far enough apart, and keep them large enough in diameter: for it is common knowledge that in the vicinity of a sharp point or a sharp edge less pressure is required to break the air down than in the vicinity of a knob or well-rounded edge. A thin wire presents along its whole length a comparatively sharp edge, and while with wires of $\frac{1}{10}$ in. diameter 40,000 volts will discharge through about 10 ft., if the wire is $\frac{1}{4}$ in. diameter discharge will only take place when the distance between the wires has been reduced to 15 in. As it is usual to space the wires on a 40,000-volt line about 48 in. apart, and as in no lines requiring such high transmission voltage, are wires likely to be less than $\frac{1}{4}$ in. in diameter, it will be seen that there need be no loss from this cause. But there is enough trouble with switches, lightning arresters and higher pressure surges in the line without brush discharge.

It is not the high pressure that makes the trouble last mentioned, indeed raising the pressure reduces surging, since the current is reduced with the increased pressure. Experience has shown that if a large amount of power is transmitted it is easier to operate lines at a pressure of 60,000 volts than at a pressure of 30,000 volts, because in the former case the current flowing is only about half. Suppose we are transmitting 5,000 H.P. to a distance of 50 miles at 30,000 volts. Roughly, the current in each wire will be 80 amperes, and it is possible that if this be suddenly interrupted the surge pressure would rise to 20,000 volts. If it happened that the line was momentarily short-circuited by a lightning discharge, and that during the short circuit four times the working current passed, the surge voltage on the removal of this short-circuit might rise to 60,000 volts, which pressure would be superposed to the working pressure. With 30,000 volts between the conductors, the pressure between any conductor and earth is 17,300 volts, so in this case the surge voltage makes the possible nearly $4\frac{1}{2}$ times the working pressure. If we worked at 60,000 volts, however, the rise on breaking the short would only be 30,000 volts, and this superposed to the working voltage gives a possible pressure of rather less than twice the working pressure. The momentary strain which insulators, transformers and other apparatus should be capable of standing is, in the case of the 30,000-volt transmission, 77,300 volts, while in the 60,000 volt transmission it is 64,400 volts. The higher working pressure has, therefore, the advantage, and if the power transmitted were increased the advantage would be more pronounced. It is probable that on account of this rise in pressure due to circumstances, the occurrence of which the greatest precaution will not always prevent, the current to be transmitted through each wire of long-distance transmission lines will not, as a general rule, exceed 100 amperes.

There is no hard and fast rule for pressures to be used, but 1,000 volts per mile is recognised as good practice. This is subject to limitation on the one hand by the highest pressures of which we have commercial experience, and, on the other hand, by the condition that the current in any wire shall not be excessive, a point which has just been dealt with. According to Mr. C. F. Scott, a distance in miles equal to three times the number of thousands of volts may be covered without incurring an excessive annual charge per horse-power for copper. This means that 5,000 volts would cover 15 miles, 10,000 volts 30 miles, and 20,000 volts 60 miles. That 10,000 volts has reached 28 miles, and 30,000 volts 92 miles is shown by the installations at work. But the solution to all engineering problems lies in compromising, and the pressure is eventually settled by striking a balance between the cost and the risks undertaken. In this country the necessity for a higher pressure than 20,000 volts is unlikely to arise, at least for some considerable time.

Up to the present I have referred to hydro-electric plants only, and it is not easy to estimate the total of the water power which has been utilised all over the world by their erection. I believe I am well within the mark in placing the total capacity of the hydro-electric power houses at work and under construction on the American Continent alone at a million H.P. In Italy, Lombardy alone accounts for 88,000 H.P. in hydro-electric power houses at work and under construction, while Switzerland, the home of hydro-electrics, accounts for 220,000 H.P. Taking the whole world, the water power utilised in the hydro-electric stations must lie somewhere between a million and a half and two millions of horse-power, a vast force, the greater part of which might have run to waste for all time, had it not been for the invention of the dynamo.

All these schemes cannot be placed in the same category. Cases are numerous in which electricity is employed merely as a means whereby the power of water can be conveniently parcelled out to various industrial undertakings in the immediate neighbourhood. Such cases furnish an example of power distribution rather than of power transmission.

It is difficult to realise what electricity has done for the mining industry. I am not thinking of its use for power distribution in and about coal mines, though, on the Continent, this has now attained gigantic proportions, but of the reduction in operating costs effected by the utilisation of distant water-power through the medium of electricity. Mines which, under the old *régime*, could not have been made to pay, have been opened up, while those that previously had just been clearing expenses have been enabled to pay dividends. It is estimated that the Sheba mine saved £10,000 per annum by introducing electric transmission, owing to the ore being then crushed in the mine instead of transported by aerial ropeway to a mill on the bank of a river 2¾ miles away. At the Burma ruby mines before the installation of the electrical transmission plant, the cost of fuel for power and lighting was £500 per month. The hydro-electric plant saved all this—£6,000 per annum—and enabled the company to begin paying dividends. By the installation of their three-phase plant, the first in the Rocky Mountain regions, the Silver Lake group of mines looked to save £7,200 per annum. These are a few instances out of many. The same tale is told in all cases.

The carrying out of power schemes in this country does not demand a fraction of the resource and originality demanded of engineers carrying out power schemes in some of the American States. Here a trench is made in the ground, an insulated cable is put in, with or without bitumen around it, and so the transmission line is laid. Nothing could be simpler, but it is a very different matter carrying a pole line over the mountains in Colorado. The construction of the pole line often presents much difficulty, though many points of interest. Until recently wooden poles only had been used, but there is a growing tendency to employ for high pressures a steel pole construction with the spans made intentionally long, so as to reduce the number of points of support. With proper care, steel poles should last at least four times as long as wooden ones, so that the sum to be set aside for renewal is much reduced, while the maintenance is also less. We shall very likely use steel poles for our power lines in this country, because we produce not wood, but steel, and have a preference for things solid and lasting; but we have easy country to negotiate compared with some of the country over which power lines run abroad, a factor which is of considerable importance.

Mr. Semenza, who has done a large amount of important work in connection with this subject, has quite rightly contended that, as in a straight line with equal spans the only strain to be borne by the line is exerted by the wind, it is unnecessary to employ poles of equal resistance in all directions, and he has accordingly designed a pole which presents great resistance in the direction of the wind, but low resistance in the direction of the line. This pole is elastic, and can deflect over 16 in. without exceeding the limit of elasticity, the consequence being that if one or two of the wires break the two nearest poles will bend, which will relieve the strain on the spans following, so that as a whole the line will stand, and no damage be done to the supports.

Needless to say, turbine construction has been influenced to a very large extent by electric power development. The design of turbines has not received much study in this country, possibly because here the sphere of their usefulness is comparatively narrow. On the other hand, the subject has been studied exhaustively on the Continent, and it is to books written in another language that we must go for our information.

But if we are backward with respect to water turbines, we make up for this as regards the steam turbine, for if Britain is not exactly the birthplace of the latter, it is the country which has seen its greatest development. To-day there are 600,000 H.P. of turbines of the Parsons type at work, and in 21 years the machine has grown from a 10 H.P. infant to a 10,000 H.P. giant. When it is remembered that the great success of the turbine has been due to the ability, energy and enthusiasm of one man, it is felt that he deserves the greatest and the best rewards that engineering has to offer.

The influence of electricity on the design of steam engines other than the turbine, is undoubted. When the dynamo first made its appearance there was no high speed engine in the market, and it was the persistent call of electrical engineers for an engine to which their machines could be coupled direct that led the late Mr. Willans to persevere and achieve such remarkable results.

Dowson, by his introduction of a heat gas, did much in the early eighties to encourage the use of gas engines, and considerable progress resulted from his work. When the possibility of burning blast furnace gas direct in the cylinder of an engine and the economy resulting therefrom were realised, a great impetus was given to gas engine construction. At the present time there are probably not less than 100 engines of over 500 H.P. working with cheap power gas to drive electric generators, and more large engines are made for this purpose than for any other. Already engines of 2,500 H.P. have been constructed for electrical work, and I understand that the designs are completed for the 5,000 H.P. size. Undoubtedly, engines using gas produced from cheap bituminous coal will figure largely in the electric power stations of the future.

I have not touched upon that department of power engineering which concerns itself with railways. It is only 24 years since the first commercial electric railway was laid down, and to-day the capital invested in street railway undertakings is something in the vicinity of £200,000,000 sterling. In this country there are about 1,800 miles of electric tramways, and about 280 miles of electric railways, of which in London alone 150 miles are opened or under construction. These figures indicate great progress, but there are many fields of enterprise as yet untilled, and in closing, I feel that I have but touched the fringe of a great subject. In the application of electricity to power work, engineering finds its mission of civilisation as well as its greatest triumph, and the power lines disappearing in the jungle, climbing to the mountain tops, spanning the torrent and descending to the fertile valley, bear to distant points, no less than telegraph and telephone, a message of peace and progress.

THE NEW TELEPHONE EXCHANGE AT GUERNSEY.

On Tuesday, the 3rd inst., at the newly built fire-proof Telephone Exchange, the official inauguration of the new multiple board, manufactured by the International Electric Co., London, took place.

The Bailiff and President of the States, Sir Henry Giffard, K.C., delivered an interesting and humorous speech, alluding to the enormous progress made within the seven years since the States telephone system was initiated, and to the fact that every twenty-seventh inhabitant of the Island can boast of a telephone.

Lady Giffard made the first through connection on the board, and was presented with a silver plug, suitably inscribed, this plug being arranged so as to be converted into a pencil case, as a permanent souvenir of the auspicious occasion.

The consulting engineer to the States, Mr. A. R. Bennett, M.I.E.E., drew up the specification, and Mr. Robert McLean, the resident engineer and manager, supervised the erection of the new multiple board, which is built of angle iron and faced by ornamental highly polished walnut. At present it accommodates 50 junction lines, 50 public call lines, and 900 subscribers in 11 operators' working places; each operator attends to 100 subscribers, separate operators being provided for the 50 junctions and 50 public call lines.

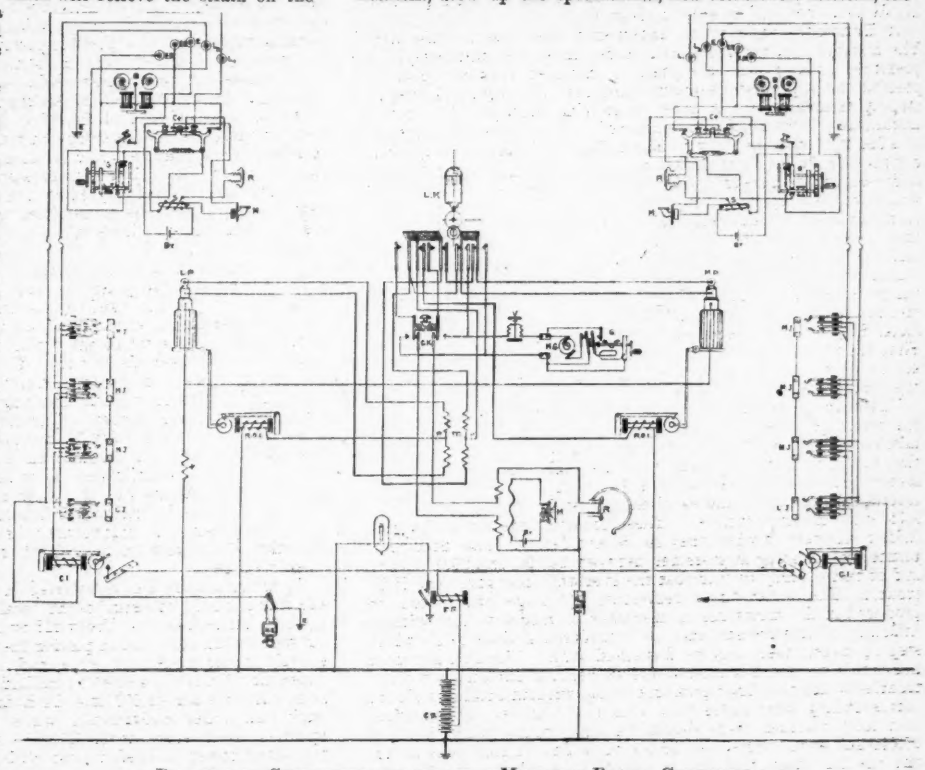


Diagram of Connections of the new Multiple Board, Guernsey.

The multiple board, however, is capable of extension to accommodate 3,000 subscribers.

A special feature of the board is the indicator employed, which forms a new departure; it is absolutely dust-proof, inaccessible to the operator, and is automatically restored by the insertion of the answering plug.

Always five movements are united in one strip, which carries, immediately underneath, the corresponding number of jacks, so that mistakes in plugging the wrong number are almost impossible.

In accordance with modern telephone practice, a double-sided ring-off has been introduced, and the somewhat difficult problem of replacing two separate movements simultaneously by one operation has been ingeniously solved by the manufacturer.

The withdrawing of the calling plug replaces automatically both differently coloured ring-offs, and the operator is not allowed to sever a connection until both ring-offs have put in an appearance.

Another important point has been secured by making conversation absolutely secret. The operator cannot, after having established the connection, cut herself in without disconnecting the two

subscribers. (Local conditions, presumably, require this special precaution).

The ring-offs are actuated by a common battery, and likewise the pilot lamps, one of which is common to every operator's position; the latter is provided with twelve pairs of plugs, of which each pair are separated by a translator (see diagram on page 659). The centre of the translator is connected through the ring-off to the battery.

Each pair of cords is controlled by a three-position ringing and listening key, and transfer keys allow the joining of adjacent operators' positions in the less busy hours of the service. A calling-back key is also at the disposal of the operator, in case that for one reason or another the calling subscriber should have left his instrument and requires to be called back, which can be accomplished by this key without changing any plugs.

All the cables are fire-proof, the carriers having been arranged so as to allow easy access to each layer of multiple cable without interfering with the remainder. The jacks can be withdrawn either from the front or from the back. The ringing and listening keys are mounted on hinged supports, allowing convenient inspection; in short, the whole board, quite apart from its neat and highly finished appearance, does credit to the manufacturers, who celebrate with this opening their third important installation of exchange work in this country.

They have previously built a new multiple board for the Portsmouth Corporation, and are just now finishing a second extension for the same municipality.

A luncheon was given by the contractors at Old Government House Hotel, Guernsey, when about 50 gentlemen sat down to a choice repast; Mr. H. Oppenheimer, general manager of the International Electric Co., presided, and amongst those present were Sir Henry Giffard, K.C., Bailiff and President of Guernsey; Lady Giffard; Major-Gen. F. B. Mainguy, R.E., President of the Telephone Council; Mr. A. R. Bennett, the consulting engineer; Mr. R. McLean, resident engineer; Mr. F. T. Purves, of the Telephone Department of the G.P.O., and Mr. C. M. Gardner, manager of the Portsmouth Corporation Telephone Department.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

14,660A. "Improvements in and relating to vapour electric rectifiers and lamps for alternating current." F. Harrison. (Date applied for under Rule 5 of the Patents Rules, 1905, July 17th, 1905.) October 3rd.

14,660B. "Improvements in apparatus for heating and in mercury vapour electric lamps used therein." F. Harrison. (Date applied for under Rule 5 of the Patents Rules, 1905, July 17th, 1905.) October 3rd.

11,036A. "Improvements in alternating current measuring instruments." F. Conrad and W. M. Bradshaw. (Date applied for under Patents Act, 1901, May 27th, 1904, being date of application in United States.) (An invention comprised in Application No. 11,036, May 26th, 1905.) October 27th. (Complete.)

11,036B. "Improvements in alternating current measuring instruments." F. Conrad and W. M. Bradshaw. (Date applied for under Patents Act, 1901, May 27th, 1904, being date of application in United States.) (An invention comprised in Application No. 11,036, May 26th, 1905.) October 7th. (Complete.)

19,853. "Improvements in electrical secondary batteries for propulsion." W. N. Caton. October 2nd.

19,865. "Improvements in apparatus or producing unidirectional high potential electric discharges for the dispersion of fog, and for other purposes." E. Wilson and W. H. Wilson. October 2nd.

19,866. "Electromobile with charging plant combined." P. Kopp. October 2nd.

19,867. "Improvements in and relating to telephones." A. Gabeaud. October 2nd.

19,899. "Improvements relating to alternating-current motors." R. Lundell. October 2nd. (Complete.)

19,906. "Improvements in electric clocks and clock systems." I. H. Parsons and A. E. J. Ball. October 2nd.

19,915. "Improvements in apparatus for applying a covering to wires or the like." M. A. Adam. (L. W. Downes, United States.) October 3rd. (Complete.)

19,937. "Improvements in and relating to electric arc lamps." Crompton and Co., Ltd., and C. F. Tubbs. October 3rd.

19,967. "Improved construction of insulator device for connecting electric lamps to their supports." L. C. H. Mensing and Bruce Peebles & Co., Ltd. October 3rd.

19,968. "Improved construction of electric switch." L. C. H. Mensing and Bruce Peebles & Co., Ltd. October 3rd.

19,969. "Improved combination of case or holder for electric resistance coils." L. C. H. Mensing and Bruce Peebles & Co., Ltd. October 3rd.

19,978. "Improvements in and relating to electro-magnetic separators." W. Blackmore. October 3rd.

19,992. "Improvements in switches for intercommunication and central station telephones." B. Hahner. (B. Hahner, England.) October 3rd.

20,024. "Improvements in electro-deposition apparatus." A. F. Harris. October 4th.

20,040. "Improvements connected with railway and tramway points operated by or from the vehicles and with points or switches for use in or upon the overhead equipments of electric railways and tramways furnished with points." J. Wild. October 4th.

20,058. "Improvements in mounting the field coils of dynamo-electric machines." Siemens-Schuckert Werke, G.m.b.H. (Date applied for under Patents Act, 1901, November 12th, 1904, being date of application in Germany.) October 4th. (Complete.)

20,068. "Improvements in receiving-systems for wireless transmission of signals." V. Poulsen. (Date applied for under Patents Act, 1901, October 8th, 1904, being date of application in Denmark.) October 4th. (Complete.)

20,099. "Improvements in or relating to electric alternating current switches." C. W. S. Crawley. October 4th.

20,100. "Improvements in or relating to Röntgen-ray tubes." "Polyphos," Elektricitats Gesellschaft. (Date applied for under Patents Act, 1901, October 5th, 1904, being date of application in Germany.) October 4th. (Complete.)

20,102. "Improvements in electric carrier systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 4th.

20,104. "Improvements in or in connection with brushes for electrical machines especially adapted for turbo-generators." J. C. B. Ingleby. October 5th.

20,106. "High tension distributor for electric ignition of internal combustion engines of more than one cylinder which is worked by one induction coil." H. J. Simmons. October 5th.

20,143. "Improvements in electric batteries or accumulators." D. H. Whitehead and Q. Marinon. October 5th.

20,152. "Improved electric ship log and indicator." E. V. R. Rizzio. October 5th.

20,155. "An automatic device for use in conjunction with the automatic control of electric arc and incandescent lighting circuits." C. F. Trippe and C. N. Staniland. October 5th.

20,158. "An improved electric switch." A. Wright. October 5th.

20,169. "Improvements relating to systems of electrical distribution." R. Braun. October 5th.

20,175. "Improvements relating to the manufacture of incandescing bodies for electric incandescent lamps." A. Just, F. Hanaman, H. Landesberger, I. Salzmann and Vereinigte Electricitats Actien-Gesellschaft. October 5th Complete.)

20,184. "Improved electrically operated displaying mechanism for advertisements and the like." H. S. Woodyer and W. E. Woodyer. October 5th.

20,189. "Improvements in and connected with the switches and exhaust lifters of internal combustion motors for cycles and the like." A. Pilkington. October 6th.

20,197. "Improvements in and appertaining to the making of talking machine 'records' by means of electricity." M. M. Robertson and J. L. Parry. October 6th.

20,217. "Improvements in apparatus for the electrolysis of water." K. J. Vareille. October 6th. (Complete.)

20,231. "Improvements in and connected with buzzers or sounders for telephone stations." H. Oppenheimer. (Akt.-Ges. Mix & Genest, Germany). October 6th.

20,269. "Electric mains, telephone and fault-detector, for use on continuous current mains of electric light systems." I. A. Carr. October 7th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

X-Ray Tube for Use with Alternate or Unidirectional Currents. A. C. Cossor. 3,166. February 15th.

Micro-Telephones. Electromilitära Aktiebolaget. (Date applied for under International Convention, March 8th, 1904.) 4,541. March 4th.

Spark Gaps for Electric Discharges. W. P. Thompson. (Ges. für drahtlose Telegraphie m.b.H., Germany.) 5,455. March 15th.

Field Systems for Continuous Current Electric Meters. C. W. J. Bisch. (Date applied for under International Convention, March 22nd, 1904.) 5,827. March 20th.

Dynamo-Electric Generators and Motors for Power Transmission. C. G. Simonds. (Date applied for under International Convention, May 5th, 1904.) 9,540. May 5th.

Ventilating Arrangements of Dynamo-Electric Generators and Motors. Siemens Bros. & Co. (Siemens Schuckert-werke G.m.b.H.) 10,085. May 13th.

Electric Target Setting Apparatus. A. J. Boult. (Phönix Electrotichnische G.m.b.H.) 11,860. June 6th.

Electrolytic Ship Bottom Cleaner. G. W. Frazier. 12,263. June 13th.

Process for the Electrolytic Production of Lustrous Metallic Coatings upon Metals. A. Classen. 12,291. June 13th.

Vapour Electric Apparatus for Rectifying Alternating Electric Currents and Other Purposes. A. M. Jackson. (Date applied for under International Convention, January 9th, 1904.) 369. January 7th.

Dynamo-Electric Machines. W. D. S. Brown and A. Greenwood. 1,004. January 18th.

Supporting Devices for Electric Conductors. B. J. Jones. (Date applied for under International Convention, March 14th, 1904.) 3,979. Feb. 25th.

Vapour Electric Apparatus. P. C. Hewitt. (Date applied for under International Convention, April 9th, 1904.) 5,409. March 15th.

Electric Arc Lamps. V. W. Riley and H. W. Rowing. 5,553. March 16th.

Means for Protecting Electric Telegraph Lines Against the Influencing Action of Alternating Current Lines Situated in the Neighbourhood Thereof. Siemens Bros. & Co., Ltd. (Siemens-Schuckertwerke G.m.b H.) 8,659. April 22nd.

Vapour Electric Apparatus. P. C. Hewitt. (Date applied for under International Convention, May 13th, 1904.) 8,973. April 28th.

Thermal-Electric Switches for Incandescent Electric Lamps. A. Frey. (Date applied for under International Convention, August 3rd, 1904.) 9,120. May 1st.

Insulation of Electric Conductors. S. Berger. (Date applied for under International Convention, May 14th, 1904.) 10,111. May 13th.

Receiver Connections for Wireless Telegraphy. W. P. Thompson. (Ges. für drahtlose Telegraphie m.b.H.) 10,709. May 22nd.

Controllers for Single-Phase Induction Motors. R. P. Jackson. (Date applied for under International Convention, June 30th, 1904.) 13,084. June 24th.

Electric Furnaces. F. A. Kjellin. (Date applied for under Internationa Convention, July 11th, 1904.) 14,214. July 10th.

Means for Producing Current or Radiations for a Transportable Wireless Transmitter Station. W. P. Thompson. (Ges. für drahtlose Telegraphie G.m.b.H.) 14,221. July 10th.

Brush Holder for Dynamo-Electric Machines. J. Burke. 1,919. Jan. 31st.

Electrical Resistances. H. W. Leonard. 2,426. February 7th.

Automatic Lubrication of Trolley Wheels for Overhead System of Electric Traction. L. J. Bedford. 2,816. February 11th.

Re-Transmitting and Re-Inforcing Telephone Currents on Lines, also Used for Telegraphic Purposes, or Otherwise Liable to have Currents of Relatively Low Frequency Passing Over Them. J. W. Kingsbury. (Western Electric Co.) 11,605. June 2nd.

Sparking Plugs for Igniting in Internal Combustion Engines. E. Evrard. (Date applied for under International Convention, March 6th, 1905.) 12,496. June 16th.

Electro-Magnets and Safety Devices Used with Cranes for Lifting Rails, Ingots, or the like. Steel, Peech & Tozer, Ltd., and H. E. Bowen. 171. January 4th.

Method of Drying Hygroscopic Insulation of Electric Conductors. G. H. Nisbett. 1,553. January 26th.

Electric Self-Acting Apparatus for Tightening Ropes and the like. H. O. Adam. (Date applied for under International Convention, February 18th, 1904.) 3,312. February 17th.